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STRUCTURE OF THE ATOM.

The mathematical problem of the motion of a ring of negatively electrified particles placed inside a uniformly electrified sphere has been suggested to Dr. J. J. Thomson by the view that the atoms of the elements consist of a number of negatively electrified corpuscles enclosed in a sphere of uniform positive electrification. He has investigated the positions of equilibrium which would be assumed by the electrons under the action of their mutual repulsion and the attraction of the sphere. Conditions of equilibrium vary steadily with an increasing number of electrons, but there are points where a sudden change occurs. These points correspond to those at which the elements change their properties in the periodic system, and it seems possible that the electron theory may be made to account for the properties of the chemical elements. The investigation so far is incomplete, as the problem considered was limited to that condition in which the electrons were distributed in a plane. The general problem of uniform distribution throughout the sphere has not yet been solved.

LABORATORIES FOR INSTRUCTION IN ELECTRICAL ENGINEERING.

Fifteen years or so ago the electrical laboratory of a technical school consisted chiefly of a number of rooms devoted to the experimental study of electrical science. These were often excellently equipped with galvanometers of all kinds, potentiometers, electrometers, Wheatstone bridges and the other physical apparatus which have played important parts in the investigation of electrical phenomena. Then, in addition to these rooms—which really were merely physical laboratories—there was a basement room containing two or three small dynamos and motors, an engine or a line shaft furnishing mechanical power, and a very incomplete set of voltmeters and ammeters, the latter often not of reliable types. A good portion of the student's time was spent in the physical laboratories mentioned above, where he continued the study of electrical science which was started in the department of physics, and thus learned something about some of the more delicate and troublesome measurements, which, while having much value as a training, had little bearing upon the work which the man would take up after graduation.

The Old Laboratory.

After having spent a good part of his time in this work, the student was allowed to go into the dynamo laboratory—so-called. There, with such machines as were to be found—and when these were not reserved for the use of some instructor—with such instruments as could be captured, he endeavored to learn something about the characteristics and temper of the dynamo. If an ammeter or voltmeter could not be found, he set up a galvanometer in some corner where it was not likely to be kicked over, and did his work with that. He frequently resorted to crude devices for instruments, but these depended upon well grasped principles.

Was the Old System Inefficient?

Study under such conditions would be severely criticised to-day. It would be said that a great deal of valuable time was being lost; that entirely too much preliminary work was necessary, and that working up the results was unduly burdensome. Finally, the critic would say that if so much time were spent on one piece of work, the number of investigations that could be carried out satisfactorily would be very limited, and the student would get an insight into the behavior of but a few machines. This is all very true in the light of what we should know to-day about electrical machinery, but it can not be denied that the training in those days turned out many good men—men who had such a thorough knowledge of the fundamental principles that they found it easy to understand the operation of types of machines which they had never handled,

and who had learned to depend upon their own resources so absolutely that they were ready to undertake any investigation with little or no equipment. It is these men that have been largely responsible for the rapid progress which has been made in the electric arts during the last ten years.

The Modern Laboratory.

To one who can recall many hours spent in a laboratory such as that just described, a striking contrast is furnished when he examines a modern electrical engineering laboratory devoted to instructional work such as that now belonging to the Massachusetts Institute of Technology, and which is described on another page of this issue. He finds that the work, now called "electrical measurements," and which took up a large part of his time, is taken care of by the department of physics, where it properly belongs. He finds that the greater part of the student's laboratory work is given up to the testing of commercial apparatus, though it is possible that the student of fifteen years ago actually spent more time on the machines he had, for in those days it was often expected that he should work in the laboratory whenever he was not required in the classroom. In the new laboratories the student finds machines of all types and sizes. He finds facilities for handling these, an ample supply of power, and accurate direct-reading instruments in sufficient number and of suitable range for any work in the laboratory. He finds, in addition, a well-equipped standardizing laboratory where he can study the best methods of carrying out any line of research, and where every facility is supplied for checking the accuracy of the instruments which he uses. This is an important part of every modern laboratory, but it was not known to the student of the early days.

The Object of the Laboratory.

Comparison of the two conditions of work emphasizes the fact that the student of to-day is expected to know a good deal more about commercial machines and is expected to have handled many types which the older student only read of in books. But does not such comparison also emphasize the fact that there is to-day a greater need for impressing upon the student the importance of thoroughly understanding his principles and of forming a clear conception of the physical reactions taking place in any particular machine, rather than becoming familiar with the external appearance and how the armature looks as it turns around? Where the student is expected to study many types in a limited time, is he not apt to be more impressed with how the thing worked than why it worked? Is he not apt to be more impressed with the beautiful way in which the machine does its work than with the beautiful application of physical principles which adapt it to its purpose? This danger is well recognized by the instructor, but the student too often overlooks it and treats the warnings of the former rather as academic objections; and believes that for the practical man such danger does not exist. With the equipments which the modern laboratories furnish, the student should accomplish much more than his predecessor, and he should leave his school much further advanced. While such equipments lighten the work of the student very greatly, they do not at all relieve him of the responsibility of making the most of what is offered to him, and of sparing no effort to train himself thoroughly for his chosen profession. The best start he can be given is a thorough grasp of the fundamental truths of his science, and the principal object of the laboratory work is to give life to these truths, to convert them from book statements to real facts.

SPECIFICATIONS FOR PRODUCING A MAN.

On another page of this issue will be found a paper by Mr. George A. Damon, which, while of particular value to the young man about to start out for himself, will also repay careful reading by those who are already at work in some branch of electrical engineering. Mr. Damon, as a basis for an analysis of the opportunities for young men in this profession, gives figures showing the progress which has been made by one hundred representative Chicago men, all of whom are engaged either directly or indirectly in engineering work. This data has been tabulated, with a view to determining the average earnings of each branch of the work. Mr. Damon has further determined the opinions of these men on a number of questions of much importance to the young man. With this information he then draws up a specification for the production of a thoroughly trained young man. The author has hit upon a very happy way of giving his advice, for in this form it has nothing of the dryness which a moral essay might have; and while practically every phase is covered, the suggestions are such as will tend to broaden and develop, rather than narrow and cramp.

Points of Interest to Students.

After reading this paper many points suggest themselves for comment, but only a few can be touched upon. It is worth noting that each man of the one hundred believes in the value of technical training, though several do not think it absolutely necessary. It should be remarked that a number of these men themselves are not technical graduates. Another point made by Mr. Damon is that the young man takes too long to find himself. In the greater number of cases he has no very definite plans, and does not know until he is well along in his training whether or not he has selected that work for which he is best fitted. This is true, yet it would be hard to see just where the blame should be laid. Is it the fault of the preparatory schools, which tend rather toward imparting information than developing the boy into the man? or is it because the young man attempts to specialize too soon? Would it be better to so plan the school work that the character of the boy would be developed, rather than to fill him with as much information as possible? or should the young man devote more time to his technical work? The boy does not legally become a man until he is twenty-one, yet by this time he is supposed to have completed his training and is ready for work—that is to say, four or five years previously he decided for what work he was best suited, and planned, though perhaps rather indefinitely, his life work. Perhaps it is not to be wondered at that he does not find himself sooner.

Pay of Technical Instructors.

Another point to which attention is called by Mr. Damon is

one which is well known, although no concerted effort has been made to improve matters. It is shown by the tables that the average age of the teachers of technical subjects is thirty-four, and that the average salary is only $2,500—nearly at the bottom of the list. The average age of the one hundred men is thirty-three and one-half years, and the average salary is $3,440. It may well be asked, why the teacher, whose work is so vitally important, should be so poorly paid? Is not the production of a well balanced, well trained, capable young man more important than the design of a dynamo? and is not each young man a special problem in himself, calling for special engineering as it were? Young men can not be moulded to templets and turned out wholesale; each requires individual treatment, calling for the highest ability in the teacher. Yet the latter is expected to do this for a salary that, in most cases, does little more than pay expenses, and lays up nothing for old age.

Reasons Why Salaries Are Low.

A number of explanations might be offered for this condition. It is unfortunately true that practically all teachers are underpaid, though a comparison such as is here made brings out the fact more forcibly. In other professions, such as medicine and law, teaching is usually a secondary part of the instructor's work. It is the primary part of the engineering teacher's, such outside work as he may do being secondary. Another factor seems to have the effect of keeping down the salaries of instructors, though it should have just the opposite effect. Capable young teachers who spend a number of years in teaching and study are soon heard of by outsiders and are drawn away by offers of much better salaries than they are receiving, and the vacancy thus made is quickly filled by another young man who is also working his way up, but who is not yet known outside. It is true that there are many men who are fond of teaching and who are not willing to give it up, even for much better pay, and who readily make great sacrifices, believing they are doing their best to advance the race; but it is unjust to take advantage of this.

Students Advised to Become Self-Supporting.

Certain of Mr. Damon's suggestions are not equally applicable to all sections of the country. He suggests that every young man should pay for his own education, and become self-supporting as early as possible. This is easier to do in the West, where tuition is free, than at certain of our eastern institutions, where the tuition fee alone is nearly as much as the western student pays for his living. But one or two points of particular interest to the student have been touched upon, as it will be better for him to read and digest the entire paper. It would be well if Mr. Damon's ideas could be presented to the young man before he enters the technical school.

NEW USES FOR CALCIUM CARBIDE.

Acetylene gas, as produced from calcium carbide, has been put to two new uses recently, both of them being interesting and possibly of considerable practical value. In one the gas generated from the carbide is made use of to empty the ballast tanks of a submarine boat and thereby bring the latter to the surface. This would seem to be an exceedingly simple, safe and cheap method of controlling submergible boats. The other application, in quite a different field, is the use of acetylene to produce high temperatures. The acetylene may be burned in a Bunsen burner or an apparatus similar to the oxyhydrogen blowpipe. M. Fouché has developed an instrument of this type, which he described recently before the French Physical Society. The flame is formed by the combustion of a mixture of acetylene and oxygen in a jet under a pressure of about six pounds. This rather high pressure is necessary in order that the flame may not travel back. It melts most metals quite readily, and will solder iron and steel, and it is said that even lime and silica may be fused.

A NEW METHOD OF DETECTING ELECTRICAL OSCILLATIONS.[1]

J. A. EWING, LL. D., F. R. S., AND L. H. WALTER, M. A.

The magnetic detector of Rutherford,[2] though now well known, appears to have created little interest until attention was directed to the subject by Marconi's adaptation of the method to his telephonic detector. Marconi's apparatus employs the change of hysteresis, which is produced in iron by the influence of electric oscillations,when these are caused to pass through a coil surrounding the iron, the change being made manifest by means of a telephone. In his view the electric oscillations act by reducing the hysteresis.[3] It occurred to us to exhibit the alteration in hysteresis by a different method—namely, by applying the principle which is used in an instrument invented some years ago by one of us for the mechanical measurement of hysteresis. In that instrument[1] the hysteresis is measured by the mechanical couple between a magnetic field and the iron, when either the iron or the magnet providing the field is caused to revolve. Thus, if the field revolves, the iron tends to be dragged after it, as a consequence of hysteresis in the reversals of its magnetism, and if the motion is prevented by a spring or other control it assumes a deflected position. Suppose, now, the electric oscillations to act on it, any change of the hysteresis caused by them will be exhibited by a corresponding change in the deflection. We anticipated, in accordance with the generally accepted view that hysteresis is reduced by the oscillations, that their presence would be detected by a fall in the deflection.

With this expectation an experimental apparatus was arranged, consisting of an electromagnet capable of being rotated on a vertical axis by an electric motor. The magnet poles were bored out circular, and between them was suspended, by a phosphor-bronze strip, a ring made up of three thin, flat annuli of soft iron, clamped together, and provided at the foot with an axial pivot. The ring was free to turn inside of two bobbins wound with fine copper wire, the windings beings at right angles to the plane of the ring. Through these copper windings electrical oscillations, produced in the usual manner by means of a distinct spark-gap, were passed.

The first experiments resulted in a very small deflection from the position due to normal hysteresis, indicating, as was ex-

[1] Paper read before the Royal Society, February 11, 1904.

[2] *Phils. Trans.*, A., vol. clxxxix, p. 1, 1897.

[3] Roy. Soc. *Proc.*, vol. lxx, pp. 341-344, 1903.

[1] *Journal* Institution of Electrical Engineers, vol. xxiv, pp. 398-430, 1895.

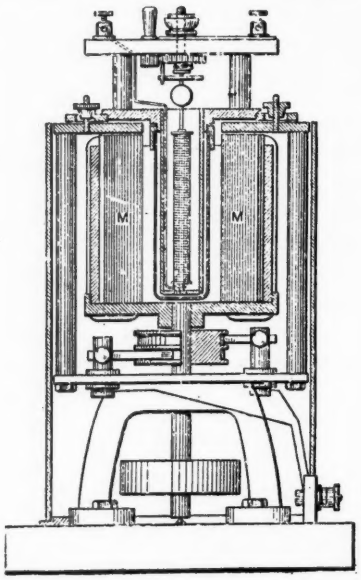
pected, a decrease of hysteresis when the oscillations arrived. The apparatus was also tested with an alternating current of about 100 periods per second in place of the oscillations, with the effect that the normal hysteresis deflection was almost entirely wiped out.

Various other forms were also tried with indifferent results, when it occurred to us that there would be advantages in passing the oscillations through the magnetic material itself, making it of magnetic wire. A small bobbin was therefore wound with insulated soft iron wire, and the ends soldered to the upper and lower halves of the spindle, which was itself divided at the centre, and the upper half bearing the controlling spring, and the lower dipping into mercury, from which a connection led to the other terminal. On passing oscillations through this winding, a remarkable and unexpected result was obtained. The change of deflection was much more marked than in the former experiments, and was in the opposite sense, indicating an increase of hysteresis while oscillations were present. Afterward, hard steel wire was substituted for the soft iron, and a very great increase in the effect was observed, still in the same direction—that of increase of hysteresis.

Owing to these encouraging results, it was decided to continue the experiments in this direction, abandoning the older form, in which a decrease of hysteresis was dealt with. The first bobbin constructed was about five-sixteenths inch in external diameter, and had a vertical wire space of one-quarter inch. The winding was a single No. 32 gauge iron wire, double cotton-covered, wound straight round from beginning to end. Later No. 40 and No. 46 steel wires were employed, of which the latter gave the best results. It was soon noticed that any method of increasing the oscillatory current in the wires, as by winding the bobbin with two wires having a slightly unequal number of turns, was of advantage in giving a larger deflection. Later, a fine copper wire secondary, wound on the bobbin parallel to the magnetic wire, was tried, first with the ends insulated, and then with the ends soldered together. A marked increase in deflection was observed when the secondary was closed, showing that the magnetic nature of the wire itself was influential. Accordingly, a bobbin was then wound with insulated steel wire, doubled back on itself. This non-inductive winding gave by far the best results hitherto attained, and is now used, except when special results are required.

The instrument, though described as a detector of electrical oscillations, may be said to measure rather than detect, giving quantitative as well as qualitative results, and being capable of regulation from a sensibility of the same order as that of an average coherer down to practical insensibility to powerful sparks in the same room.

In the instrument, as shown in the figure, the electromagnet takes the form of a ring capable of moving round a vertical axis, and is provided on the interior with two long wedge-shaped pole-pieces, M,M, the current to the winding being supplied through brushes bearing against insulated rings below. The magnet is



EXPERIMENTAL APPARATUS FOR DETECTING ELECTRICAL OSCILLATIONS.

made to revolve by an electromotor, the best speed being about five to eight revolutions per second, but the electromagnet may be replaced by a permanent magnet system giving a similar field. A structure is built up, external to the magnet, to support the vessel containing the pivoted bobbin and its centering arrangements. The bobbin itself is made of bone, and is about two inches long. It is provided with a steel spindle at each end bearing in a jewel hole, the two halves of the spindle being insulated from one another. The winding, which is, as far as possible, non-inductive, consists of about 500 turns of No. 46 gauge, hard drawn steel wire, insulated with silk. The bobbin is immersed in petroleum or a mixture of petroleum with thicker mineral oil, which serves the double purpose of fortifying the insulation and giving the damping effect necessary to steady the deflection due to the drag of the revolving magnet. Readings are taken by means of a spot of light, as with speaking-mirror galvanometers, but a siphon-recording attachment has been fitted, and any form of contact for working a relay could be employed.

The detector, as before mentioned, gives quantitative readings, and, in some cases, the deflection may be too large to be easily read by the scale. For this purpose a variable shunt is provided, by which the deflection can be regulated. For the purpose of wireless telegraphy, the instrument has the advantage of giving metrical effects. The benefit of this in facilitating tuning, and in other respects, need not be insisted upon.

From the physical point of view, the augmentation of hysteresis is interesting and unlooked for. It is probably to be ascribed to this, that the oscillatory circular magnetization facilitates the longitudinal magnetizing process, enabling the steel to take up a much larger magnetization at each reversal than it would otherwise take, and thus indirectly augmenting the hysteresis to such an extent that the direct influence of the oscillations in reducing it is overpowered. The net result appears to be dependent on two antagonistic influences, and, in fine steel wire, under the conditions of our experiments, the influence making for increased hysteresis, as a result of the increased range of magnetic induction, is much the more powerful.

An Electromechanical Coupling.

An ingenious electromechanical coupling, which allows a continual change of speeds from zero to a maximum, was described recently in a note presented to the French Academy of Sciences. This mechanism consists of a prime mover, a motor, a dynamo and an epicyclical gearing. The prime mover transmits a certain portion of the power directly to the machine to be driven. The rest of its power is absorbed by the generator, which, in turn, drives the motor. The train of epicyclical gearing is acted upon simultaneously, both by the prime mover and the motor, but the two machines have different speeds varying the speed of the motor, so that the desired change may be made.

The principal danger from electric cables in mining is in sending through them too great a current, thus causing the wires to become heated and setting fire to timber or other woodwork. Where the wires are bare and are used for overhead trolleys, should the person passing along the track chance to come in contact with the wire and his cap be wet he is likely to sustain a severe shock, though usually the voltage is so low in electric mine traction plants as not to render such shock fatal.

SUGGESTIONS FOR PRODUCING HIGH-FREQUENCY CURRENTS AND SOME OF THEIR PHENOMENA.

(Concluded.)

BY EDWIN F. NORTHRUP AND ELLIOTT WOODS.

Two views, reproduced from photographs, of two coils constructed on the general lines described above are illustrated in Figs. 5 and 6. The coil shown in Fig. 5 gave a very good twenty-inch discharge. The terminals in the picture, Fig. 5, are shown twenty and one-quarter inches apart, from which standard of reference the reader can determine the other dimensions of the apparatus. The coils shown in Figs. 5 and 6 had their secondaries wound on glass jars which set on the inside of larger glass jars around which the primary coils are wound. The construction as indicated in Fig. 3 would, however, if followed, have been somewhat more efficient. The primary turns, as indicated above, should preferably be made of copper strip, as the high-frequency currents in the primary coils are chiefly confined to the surface of the conductor and by using copper ribbon instead of round wire as actually used, it is possible to surround a larger portion of the secondary windings without increasing the number of primary turns.

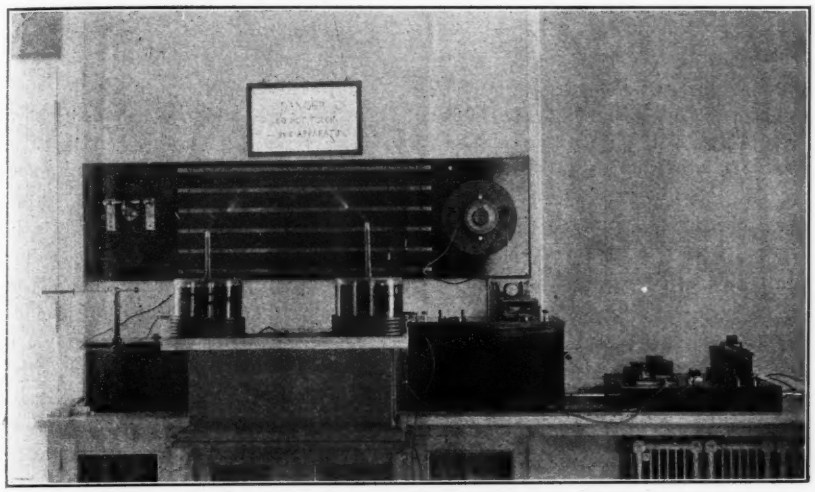


FIG. 5.—COIL FOR TWENTY-INCH SPARK—SUGGESTIONS FOR PRODUCING HIGH-FREQUENCY CURRENTS.

Experiments with the coils illustrated in Figs. 5 and 6 showed that for obtaining the maximum length of discharge a certain number of primary turns were required. For the coil shown in Fig. 6 four turns on each half seemed to give the best result. The efficiency of the high-frequency coil in regard to length and volume of discharge is greatly increased when the leads to the primary windings, or, in other words, the connecting wires in the circuit in which the electricity oscillates, are kept as short as possible. The discharge from a high-frequency coil will vary in volume, as well as in length, very greatly, according to the form of construction of the apparatus and the power which is put into it. A coil such as has been described above, when the transformer is taking about twenty amperes at 110 volts and 7,200 alternations per minute, should give a discharge of sufficient volume to bring the filament of a 110-volt sixteen-candle-power lamp to a bright red when passed through it. We have seen as many as ten incandescent lamps brought nearly to candle-power when joined in series and the discharge from a high-frequency coil, capable of giving eight inches, passed through all of them. Observations taken on a wattmeter which measured the true power put into the apparatus apparently showed that the apparatus was taking less power than would be required with ordinary currents to light ten lamps to two-thirds candle-power, as they actually were lighted from the high-frequency discharge which was passed through them. To all appearances the filaments were brought to incandescence by true conduction currents. As far as the indications went, a considerably larger number than ten lamps could have been lighted in the same way and to the same brilliancy; as one lamp, when the current was passed through it alone, was lighted no more brilliantly than when passed through ten in series, and an air-gap, in series with the lamps over which the discharge passed, very slightly, if at all, diminished their glow. The explanation of this apparent paradox, that more energy was displayed in the lamps than was actually put into the apparatus, as measured by a wattmeter measuring true watts, can not be satisfactorily given by the writers. No opportunity has been presented to investigate the matter experimentally so as to reach a certain conclusion. We consider any explanation based upon theory as of little value and a study of the interesting phenomenon above described is suggested as being well worth the trouble. Any high-frequency

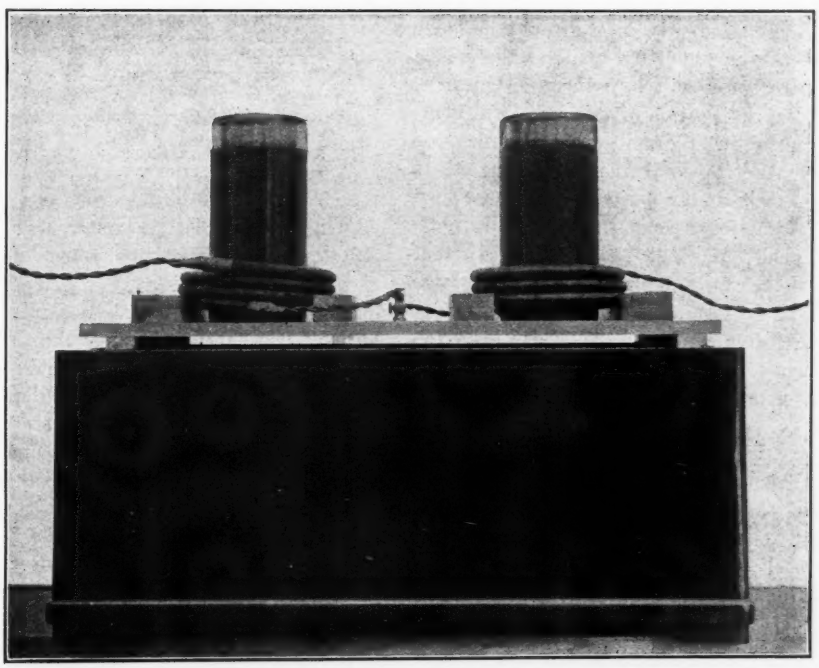


FIG. 6.—NO. 2 COIL—SUGGESTIONS FOR PRODUCING HIGH-FREQUENCY CURRENTS.

discharge which is not of sufficient volume to light up lamps, when passed directly through their filaments, may be considered poor as to what may easily be obtained by proper construction.

Many experiments were tried by the writers with the high-frequency apparatus shown in Figs. 5 and 6. None of the experiments was strictly new, having been described by Tesla and other writers, and only a brief mention will be made of some experiments which indicate strikingly the properties of high-frequency currents, which show phenomena totally unlike direct currents and those of moderate frequency. Thus, presenting a piece of metal held in the hand to one terminal of the high-frequency coil draws a discharge from the terminal into the body, even though the body be insulated by a stool with glass legs. Simple and common as is this observation to those familiar with high-frequency currents, it would be inexplicable to one who does not appreciate that electricity always flows in a closed circuit, and that the circuit, according to Maxwell's theory, is, for high-frequency currents, as perfectly closed through the dielectric medium as it is through a wire for ordinary currents. The experiment as described can be performed without any disagreeable sensations, but, contrary to the common notion, if the discharge is taken through the body by grasping both terminals of the coil, a severe shock will be felt. Our guess as to the explanation of this is that in addition to the high-frequency electromotive forces set up in the coil, there are others of much slower period which cause currents of lower frequency to pass through the body, and that it is these currents that give the shock. When the body is insulated and one terminal is touched, it is only the currents which have a very high frequency that can pass into the body and these produce little or no sensation.

To obtain from a high-frequency coil a most brilliant display of light, proceed as follows: take a large piece of plate glass and fasten a piece of tin-foil about as big as a dollar on each side of the glass near its centre. Connect to each piece of tin-foil a terminal of the coil. When the coil is in operation, even if it is a very large one, the discharge will not puncture the glass, but will spread out in fiery streamers on each side of the glass like the roots of a tree, covering a wide area and producing a most beautiful effect, especially when seen in the dark.

All kinds of vacuum tubes, including electric light bulbs, can be made to glow brightly by being held in the hand and approached to one terminal of the coil. Vacuum tubes will generally glow if suspended between two metal sheets which are connected to the terminals of the coil. Many other experiments along the same line, which attracted such lively attention when first exhibited in a striking manner by Tesla, can be performed with a coil constructed like those described above.

A very beautiful display of light and a high-frequency discharge of considerable length can very easily and inexpensively be obtained by constructing an air-insulated coil made as follows: Describe on the top of an old wooden table two concentric circles, the inner one about three feet in diameter and the outer one about four and one-half feet in diameter. On the circumference of each circle bore fifteen or twenty evenly spaced holes. In each hole insert a rod about three feet long, of hard, dry wood, glass or fibre. Around the upright rods of the inside cir-

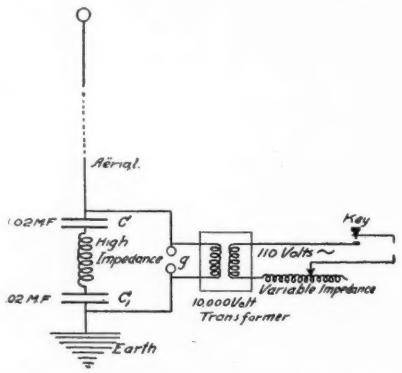


FIG. 7.—METHOD FOR EXCITING THE OSCILLATIONS.

cle wind in a single layer anywhere from 500 to 1,000 turns of fine wire, the coil of wire thus formed reaching from the bottom to the top of the rods. Bring the bottom terminal up through the centre of the coil, fastening it to a suitable support above the coil. Wind around the outside circle of upright rods, eight or ten turns of heavier wire, say No. 12; making the outside turns the primary and the inside turns the secondary of a high-frequency coil, the other parts of the high-frequency apparatus being the same as we have described above, a high-frequency discharge of a foot or more in length may be obtained. If the terminals of the secondary are separated, so that the discharge can not pass, the wire coils formed as above will appear, when viewed in a darkened room, like a huge, brilliantly glowing cylinder of purplish light. One of the writers once entertained a small audience of ladies and gentlemen for an hour and a half with a display of a large variety of light effects obtained with a high-frequency apparatus, and we know of no more pleasing entertainment than can be furnished with properly selected experiments performed with a high-frequency apparatus of large power.

The high-frequency currents of low potential which pass through the primary circuit only may be made to yield in a simple manner many striking effects of induction and impedance. Thus an impressive but simple experiment is performed as follows: a single turn of heavy wire is made to complete the condenser circuit. Another single turn of heavy wire is connected near its ends by a suitable mounting upon which a small lamp socket is placed, containing a lamp of about six candle-power. The mounting of the lamp is so arranged that it can be used as a handle. When the condenser current is flowing through a single turn of wire and this is approached with the turn holding the small lamp, the latter will light up when the turns are at some little distance and can readily be made to give its full candle-power. One of Tesla's experiments is easily performed with great success as follows: a one-quarter-inch brass rod ten feet long is bent at its centre so as to form a narrow arch, the vertical sides of which are about ten inches apart. Suitable slides are made to work on these rods and upon these slides electric lamp sockets are placed. As we performed the experiment, a sixteen-candle-power lamp was placed in one socket near the bottom of the arch. Near the centre of the arch a ten-candle-power lamp was placed. Near the top an eight-candle-power lamp. When the current is taken from the condenser and passed through the arch, the phenomena of impedance are strikingly shown by these lamps. The lower lamp lights up nearly to full candle-power. The middle one remains dark, and the upper one, if care is not taken, will quickly burn out.

These simple experiments, and a great many others which space will not permit us to describe, can be performed by any one and the appliances for them can generally be made with very little trouble.

So many of these experiments come to the mind of one working with high-frequency currents, and go to show in a most convincing manner how influential are the effects of capacity, impedance and molecular bombardment, that it seems to us that the physical laboratory of any school or college is not complete unless supplied with apparatus for the production of high-frequency phenomena.

As the spectacular features of high-

frequency currents increase with the length and volume of the discharge which is obtained, it is of interest to many persons to strive to obtain the most powerful apparatus which can be built. The largest apparatus, for which the writers have specifications, gives a discharge of thirty-two inches.

It is probable, however, that an apparatus could be constructed which would give a discharge of considerably greater length and volume sufficient to bring sixteen-candle-power lamps to incandescence. The experience of the writers would indicate that the form of construction shown in diagrams 1 and 3 is that which is best adapted to obtaining the longest possible discharge lengths with greatest safety in insulation, and with apparatus constructed in the smallest compass. Whatever the length of discharge one wishes to obtain, the apparatus should be proportioned as above described. Roughly speaking, the length and diameter of each half of the secondary coil should be the same. For each inch of secondary winding of one-half of the secondary coil, two inches of discharge can be obtained. A good oil to use for the insulation is a clear thin paraffin oil, and its dielectric strength can be reckoned as at least ten times that of air for high-frequency potentials. As shown in a previous article by one of the writers, the dielectric strength of oil is greater for high-frequency potentials than for low-frequency potentials. If the above considerations hold beyond the range over which the writers have experimented, one ought to be able to obtain a discharge five feet in length with a coil, each half of which has a secondary winding about thirty inches high and about thirty inches in diameter at its base, and about twenty-two to twenty-four inches at its top. Of course, the greater the discharge length with a discharge having a given thickness, which one wishes to obtain, the greater must be the capacity of the transformer which charges the condenser. Our experiments indicated that the primary of the transformer required about one ampere at 110 volts pressure for each inch of high-frequency discharge, which had sufficient volume to light an incandescent lamp of sixteen candle-power. If great discharge lengths are sought, the condenser should be arranged to withstand a potential that will disrupt a parallel gap of at least one and one-half to two inches. The most feasible way to obtain a condenser of this strength and of sufficient capacity is to construct four condensers like the one described above, and join two pairs in series. It may here be remarked that to double the dielectric strength of a condenser and maintain its capacity unchanged, its volume must be increased four times. It is better to make several condensers and join them together in the combinations required for the capacity and dielectric strength sought, than to make one large condenser. In the former case, various capacities can be obtained for experimental purposes, and breakdowns are much more easily repaired.

The commercial uses of a powerful high-frequency coil are not very obvious at the present time. A coil, however, giving a six-inch discharge is very useful for the production of X-rays, chiefly where these are to be used for therapeutic purposes and where sharpness of definition is not essential. A coil of moderate power will excite a large tube to its fullest capacity, which will very brilliantly light fluorescent screens. It is possible that the physiological effects produced by charging the body of an insulated person from one terminal of a powerful coil may have certain beneficial effects.

Unquestionably, the best method of charging the aerial wire in wireless telegraphy experiments is by means of an oscillating discharge made with condensers and a transformer. One of the writers in April, 1902, made several experiments on the application of a transformer and condensers to exciting oscillations in the aerial of a wireless telegraph station. We can not enter into a full description of this much discussed subject, but for reference a diagram is here given of one method for exciting the oscillations, which was tried with great success. Consult Fig. 7, which is self-explanatory to those familiar with wireless telegraphy. The method shown in the diagram is only one of several that were successfully tried. The large impedance, which consisted of the secondary of a small induction coil, permitted the two condensers C and C to become charged from the transformer, but when the air-gap broke down a powerful surge of electricity was produced up and down the aerial and through the air-gap *g*, the resistance of which is greatly reduced by the heavy flow of current from the condensers and transformer. This was proved by the action on the coherer, the blowing of the fuses in the electric light circuits of a near-by building, as well as by the fact that sparks of considerable length could be drawn from the aerial a third way up its length into an insulated conductor, such as the blade of a shovel, which was held near it. In these experiments, the discharge across the gap would answer instantly to the most rapid tapping of the key, and the energy available was vastly in excess of what might be obtained from an induction coil.

In conclusion, we have to say that the phenomena of oscillating currents and high-frequency discharges are so complex, and the observations made so unexpected, that one must rely almost entirely upon experiment to learn what will happen each time that the conditions are slightly varied.

A Portable Electric Mining Lamp.

A paper presented recently before the British Institution of Mining Engineers described a small portable electric lamp which has been used for some time at the Bruay collieries, Pas-de-Calais. The lamp is known as the Neu-Catrice. It consists of a box of sheet lead containing two accumulator jars made of celluloid or semi-plastic india-rubber. Each jar contains one positive and two negative plates, the two giving a mean voltage of 3.9, sufficient to supply a small incandescent lamp of about one candle-power for fifteen consecutive hours. The lamp is mounted on top of the lead case and is protected by a glass globe, one-half of which is coated with a semi-translucent white varnish, which acts as a reflector and allows a small amount of light to be diffused backward. The lamp is carried by means of a hook attached to three vertical rods which partially protect the globe. Two sizes of this lamp are made—one weighing three pounds, fourteen ounces, giving 0.8 candle-power for eleven hours, the other weighing five pounds and giving one candle-power for fifteen hours. The dimensions of the small lamp are ten inches high, two and three-eighths inches square, and for the larger, ten inches high and three inches square. The lamp takes less than three and one-half watts per candle-power and lasts for 500 hours. It is charged at the rate of one ampere for twelve hours. After being fully charged it is partially discharged through a thirty-two-candle-power lamp, in order that the high initial voltage of the cells may not injure the small lamp. Five hundred and four of these lamps are in daily use at the mine mentioned above. About ninety-seven per cent are kept in commission, the others being laid up for minor defects. The cost of maintenance is said to be one cent per day. The lamp is considered absolutely safe in gaseous atmospheres, and is very reliable.

The Augustus Lowell Laboratories of Electrical Engineering of the Massachusetts Institute of Technology.

Description of One of the Most Completely Equipped Laboratories for Instruction in Electrical Engineering in the World.

THERE is no need to dwell upon the important part being taken in our industrial development by the engineering schools. This is recognized by all, though few appreciate the difficulties encountered in giving the would-be engineer a suitable training, or the elaborate and expensive equipments which are now being used for this purpose and which are to-day rather the rule than the exception. One of the newest and most complete equipments for instruction purposes is that contained in the Augustus Lowell laboratories of electrical engineering, the latest addition to the Massachusetts Institute of Technology at Boston.

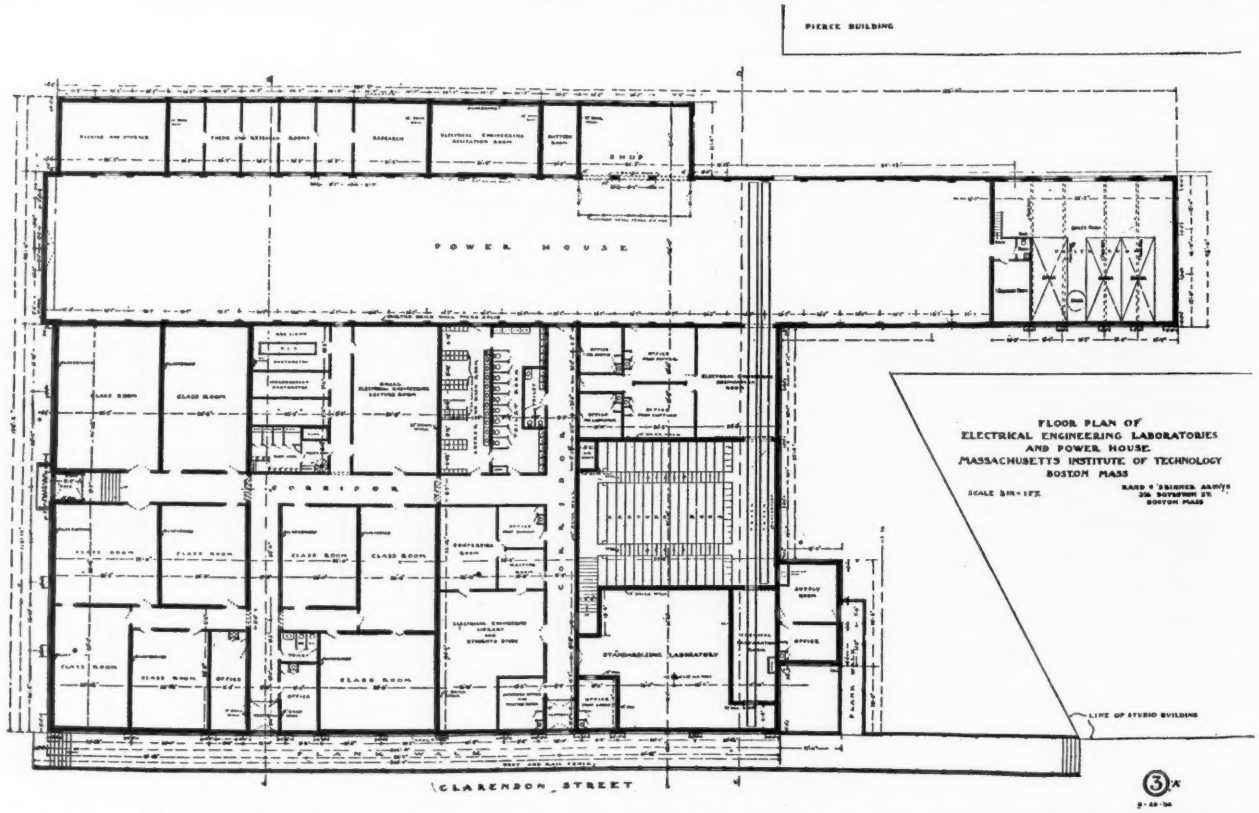


FIG. 1.—FLOOR PLAN, SHOWING GENERAL ARRANGEMENT OF AUGUSTUS LOWELL LABORATORIES, MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

In laying out a new course of technical instruction or improving an old one, the head of the department is confronted with a problem which, due to the many conflicting conditions and demands which must all be met and harmonized, is worthy to be classed with the most important engineering problems of the day. The task is to impart to the young man just from school as much training and, at the same time, as much information as possible in four years; these two requirements which are generally in conflict. A course which furnishes information only turns out a man with a general idea of current practice, but ill fitted to carry on the engineering work of the world; while, on the other hand, where training is the one object sought, the graduate may be well prepared to take up his engineering profession, but is sadly lacking in knowledge of the contemporary state of the art. A course of instruction must be adopted and followed which will train the young man thoroughly in the principles of engineering, and yet not send him out heavily handicapped by not knowing the progress that has been made by his profession.

To lay out a satisfactory course, compromises must be made, as in any engineering work. The student has a certain amount of time to invest, from which the best results must be obtained. The course must be divided into classroom work and laboratory work, and each of these must again be divided between the study of theory and of practice. For example, it is highly desirable that in the laboratory the student should prepare the apparatus for his experiments, not only that he may be familiar with the connections of his instruments and machinery, but that he may obtain a certain facility in such work. But this preparatory work may easily be carried to extremes, so that the greater part of the work in the laboratory consists in setting up and connecting instruments and apparatus. Where this is the case the student is apt to get the idea that the principal object of the laboratory work is to learn to connect up properly the machine which has been assigned to him, and that the readings which he obtains when the preparation has been completed simply show that the work of connecting has been done correctly. On the other hand, if the apparatus is set up permanently and the student is given an instruction sheet, telling him what switches to throw, what handles to turn and what readings to take, it frequently is true that he does not understand at all what he is doing, or why he is doing it. It may easily happen, under such conditions, that what appears to be a good report is made on work carried out without accident, yet the stu-

dent has not at all grasped the object of his experiment. A laboratory arranged on the latter plan has the advantage that the apparatus is not so exposed to mishaps as when the student arranges it himself; but, on the other hand, accidents have themselves an instructional value, and by the use of protective devices, damage to the machinery can, in general, be avoided. The student seldom tries to start a shunt motor without a starting box more than once, even if the only result of his first attempt is the unexpected opening of a circuit-breaker.

After having laid out the course of instruction so as to preserve the proper balance between theory and practice, the equipment of the laboratory demands attention, and here, as everywhere else, compromises between conflicting conditions must be made. The fund available for apparatus is always limited, and while, for some reasons, large units are desirable, many types of machines must be provided, and hence smaller sizes are usually decided upon. Electrical energy in various forms and under various pressures must be available, and a sufficient number of accurate instruments are needed. The apparatus must be arranged so that it is available for many purposes. In short, the equipment must be as flexible as possible. All of these machines and instruments are expensive and great care and judgment are necessary to obtain the requisite equipment without providing a lot of machines which are hardly more than toys.

An electrical laboratory usually has three classes of work for which to provide. Sometimes there are more. There is, first, the routine work of the electrical engineering students. In this work the men are supposed to obtain a certain facility in setting up apparatus and instruments, and, at the same time, to study the behavior of the various types. The second class of work is the thesis investigation which these men usually carry out during their senior year. This work is generally original so far as the student himself is concerned, and most frequently consists of a large amount of experimental investigation on one particular machine or type of machine. For such work a permanent arrangement is highly desirable. The third class of work which must be handled is the laboratory instruction given to students who are following other engineering courses, and in which it is endeavored to give them a general idea of the operation of electrical machinery and of the character of the work which can be done. Such instruction is highly desirable, as it teaches the members of each branch how the other branches can assist them.

In addition to these three classes of work there is frequently a fourth. This is the advanced investigation carried out either by graduate students or by the instructors themselves. Such work is highly desirable, not only because it helps to advance the profession, but because it aids in the development of the laboratory and maintains the interest of both students and instructors. A further requirement, not infrequently met, is that of supplying light and power for other buildings.

It is evident that the demands of these several classes of work can not all be fully satisfied, but it is the object of every laboratory equipment to do this as far as possible. This should be borne in mind in the examination of any laboratory, as the value of the equipment depends not so much upon its variety and the size of the units, as upon the amount of service which can be got out of it; and of great importance here is the means provided for distributing power to the various parts of the laboratory and for shifting and grouping machines. Attention to these details largely increases the usefulness of the entire equipment.

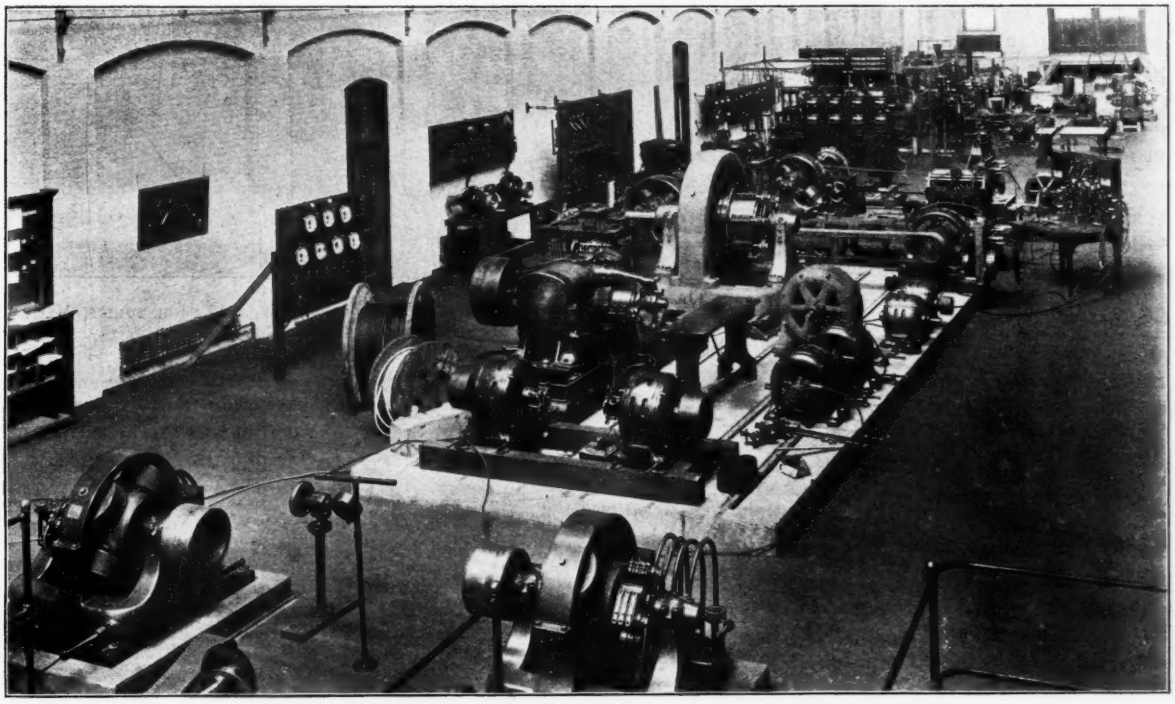


FIG. 2.—LABORATORY OF DYNAMO ELECTRIC MACHINERY, LOOKING SOUTH.

The Augustus Lowell laboratories of electrical engineering are in a one-story building located between Clarendon street, Trinity place and Stanhope street, within a few minutes' walk of the main group of buildings. This building was erected during the summer and early fall of 1902, and with its equipment (when the latter is completed) will be valued at $100,000. It is built on a factory basis, lighted by skylights instead of windows, and covers over forty thousand square feet of ground.

The accompanying floor plan, Fig. 1, shows the general arrangement adopted. All of the rooms shown on this plan, except the group of nine classrooms and the two offices in the lower left-hand corner, and the chemical preparation room, supply room and office at the lower right-hand corner, are occupied by the department of electrical engineering. The main room is the dynamo laboratory, here marked "power-house." This room is about 324 feet long and forty-two feet wide, and is traversed from end to end by a ten-ton electric crane, with the exception of the extreme right which is cut off for the boiler room. The ultimate capacity of the boiler room is three 250-horse-power boilers. At present but two are in place supplying steam to the driving engines. At the top of the plan are a number of small rooms used for research, recitation, storage, a battery room and for a well equipped shop. Adjoining the main entrance on Clarendon street are two small offices not used by the department. On the right side of the corridor is the large standardizing laboratory, and on the left a library, a study and offices for the head of the department. Adjoining the standardizing laboratory is the large recitation room, and adjoining this is the electrical engineering preparation room and four offices for instructors. About the centre of the plan is a small lecture room, and across the corridor from this are several small rooms, two of which are fitted up for photometric studies. It will be seen that the arrangement of rooms is compact and convenient, and in spite of the closeness of the dynamo room to the other rooms there is practically no disturbance in the classroom, due to the running of the machines.

The special arrangements adapted to facilitate working in the laboratories are the electric crane mentioned above, a testing floor twelve feet by thirty feet, a large and complete switchboard, and a liberal number of supply circuits laid in ducts under the floor and running to all points of the room. The testing floor, which can be seen in the centre of the illustration (Fig. 2), showing the south end of the laboratory, is of concrete, in which tee-rails are embedded. The grooves beside the head of the rail enable special clamps to be slipped down around the rail, where they serve to bolt down securely any machine in any position. These grooves also serve to catch any water thrown upon the testing floor and carry it off through suitable drains. This is a detail, but a great convenience in testing work, as water can be used freely for cooling brakes and in water rheostats, without the nuisance of having it run about the floor of the dynamo room. By means of the crane any of the smaller machines in the room are easily transferred to the testing table, and by means of the circuits under the floor are quickly connected so as to be supplied with power from any of the laboratory sources.

The distributing switchboard, which is shown in Fig. 3, serves not only for laboratory purposes, but, as well, for the light and power distributing board for the generator plant. This plant not only furnishes power to the laboratory and serves as part of the experimental equipment, but also supplies light and power to the other institute buildings. The switchboard, as will be seen, does not differ from those erected in commercial plants.

A view of the shop is given in Fig. 4. This, as mentioned before, is located in a bay at the side of the laboratory, and is well equipped with machine tools. It serves for such repair work as may be necessary and for preparing such special devices as are needed in the laboratory, or for research work.

A view of the main generating units is given in Fig. 5. The large unit in the background is a 480-kilowatt double-current generator, directly connected to a cross-compound Russell engine. This generator has a six-phase connection on the alternating-current side, enabling single, quarter-phase or three-phase currents to

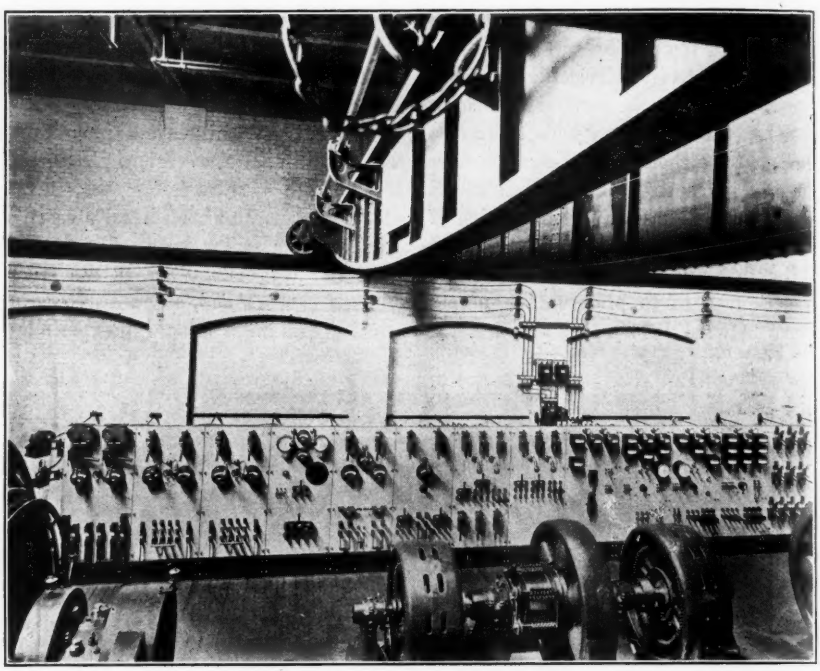


FIG. 3.—THE DISTRIBUTING SWITCHBOARD, AUGUSTUS LOWELL LABORATORIES, MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

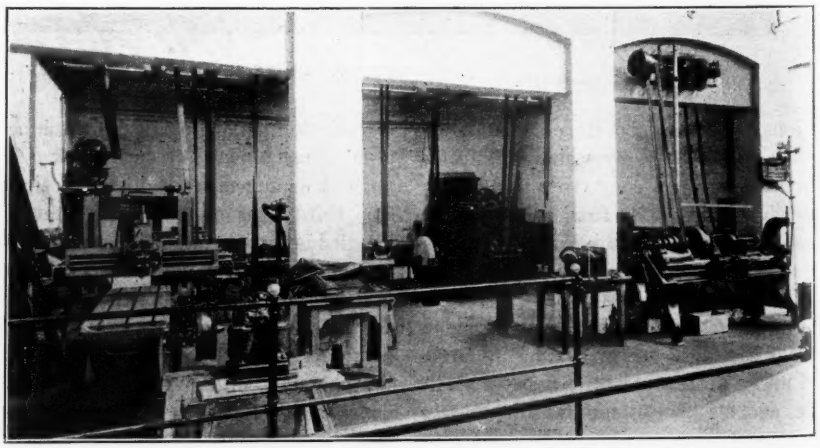


FIG. 4.—THE LABORATORY SHOP, AUGUSTUS LOWELL LABORATORIES, MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

be drawn from it. A closer view is given in Fig. 6. In the foreground of Fig. 5 is a 150-kilowatt Westinghouse three-phase generator driven by a tandem compound

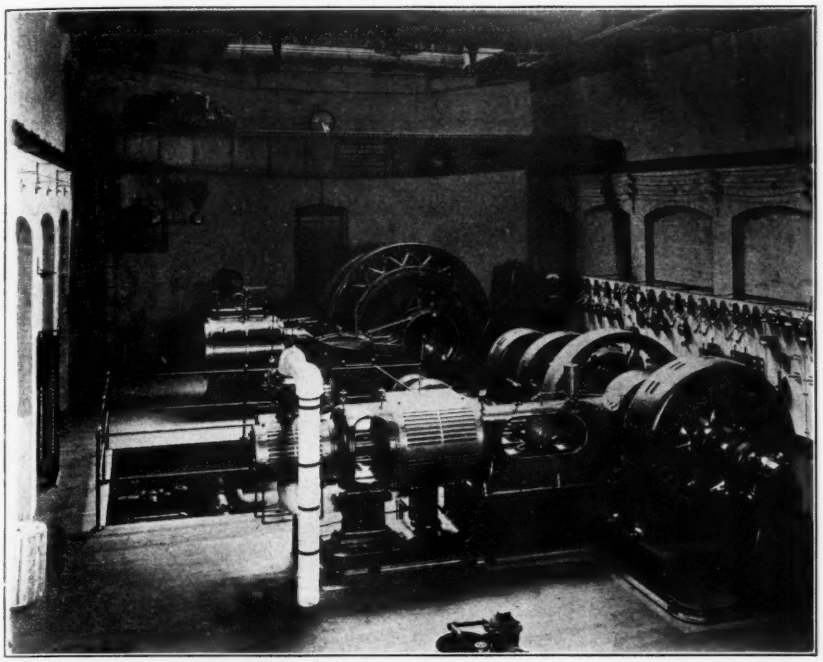


FIG. 5.—THE ENGINE ROOM, AUGUSTUS LOWELL LABORATORIES, MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

Ridgeway engine. Between the two units are a 100-kilowatt sixty-cycle dynamo and a fifty-kilowatt twenty-five-cycle dynamo

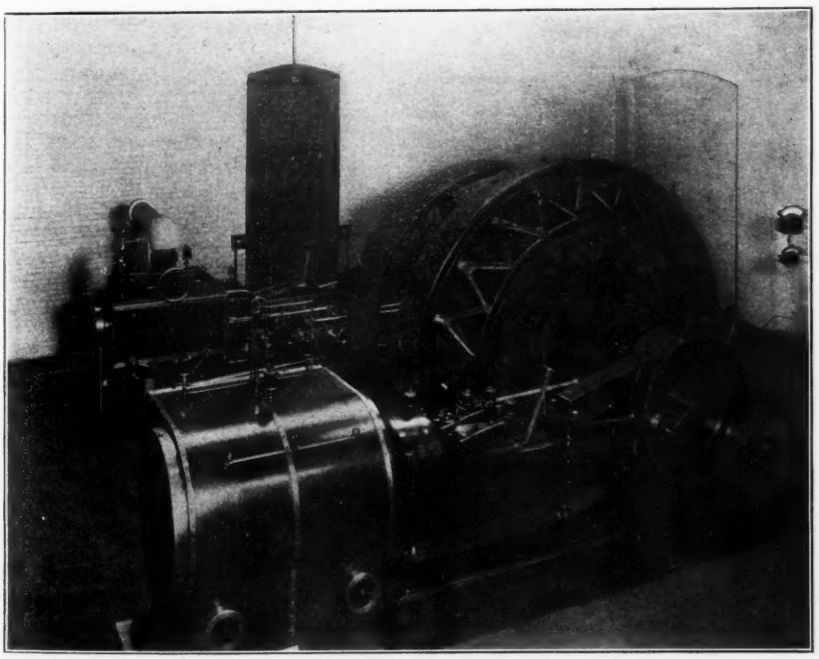


FIG. 6.—THE MAIN GENERATING UNIT, AUGUSTUS LOWELL LABORATORIES, MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

driven by a 150-horse-power motor. These three machines are on the same bed-plate. A side view of the group is given in the foreground of Fig. 3. On the left of Fig. 5 is seen the condenser. This is of the surface type, is located in the basement, and operates in connection with the cooling tower located just outside the power-house. Between the Ridgeway engine and the testing floor are two seventy-five-kilowatt direct-current dynamos driven by Westinghouse engines. These two units form a complete plant in themselves, and serve not only for furnishing power to the laboratory, but are excellent sets for testing and demonstrating work. In addition to this machinery there are two twenty-five-kilowatt direct-current machines driven by a 100-horse-power Westinghouse engine. These machines complete the generating equipment of the laboratory. This is arranged so as to be available for testing as individual machines, and also as complete generating plants, enabling the cost of power to be determined from actual runs.

To obtain a variety of currents there are a number of transformers and motor-driven dynamos, the motors of which are operated by current from the power-plant. Thus, there is a 150-kilowatt Scott transformer, a fifty-five-kilowatt transformer of the three-phase type, a fifty-kilowatt twenty-five-cycle rotary converter, with compounded field windings, a variable reactance and a starting compensator, and two fifteen-kilowatt three-phase machines which may be operated at any frequency between twenty-five and seventy-five, and are useful for running in parallel or as a generator and synchronous motor. Different types of motors, both single, polyphase and for continuous current, are available for experimental work. These are supplied with various types of armatures, and the greater number are rated at less than ten-horse-power. There is a complete electric car equipment. There are also supplied various types of arc light dynamos, a constant-current transformer and a two-kilowatt generator for giving very high frequencies which are used for studying the behavior of inductances and capacities. Testing transformers wound for 100,000 volts enable puncture and insulation measurements to be made on materials used in high-voltage work.

To list all of the machines located in the dynamo room, and available for laboratory work, would be tedious. The aim has been to provide an ample power supply and a sufficient number of machines of all types to meet all demands, and though many of them are rather small, they are large enough to demonstrate the behavior of each type.

Of equal importance with the dynamo laboratory, though perhaps not as showy, is the standardizing laboratory. Two views of this are shown in Figs. 7 and 8. This laboratory serves not only for standardizing and calibrating the laboratory instruments, but in here the student determines the best methods or apparatus to be used in any particular investigation. Emphasis is laid upon this, as well as upon the accurate checking and calibration of instruments. Before the student is allowed to take up actual experi-

mentation he is required to submit to the instructor a study of the methods of measurement to be adopted, a list of the apparatus and instruments which will be required, a detailed sketch of the arrangement of circuits which will be required for carrying out the investigation, and a statement of what is intended to be demonstrated by the work. The standardizing laboratory is provided with direct and alternating currents, the latter at frequencies of sixty and twenty-five and in quantity up to 4,000 amperes and in voltages up to 50,000. Direct currents are available up to 1,000 amperes and potentials as high as 3,000 volts. The laboratory has a full complement of standard ammeters, voltmeters and potentiometers. There are sets of standard resistances, inductances and capacities, and numerous other special devices such as oscillographs, wattmeters of various types, a special generating set for testing the latter, sensitive galvanometers, recording instruments and other necessary devices.

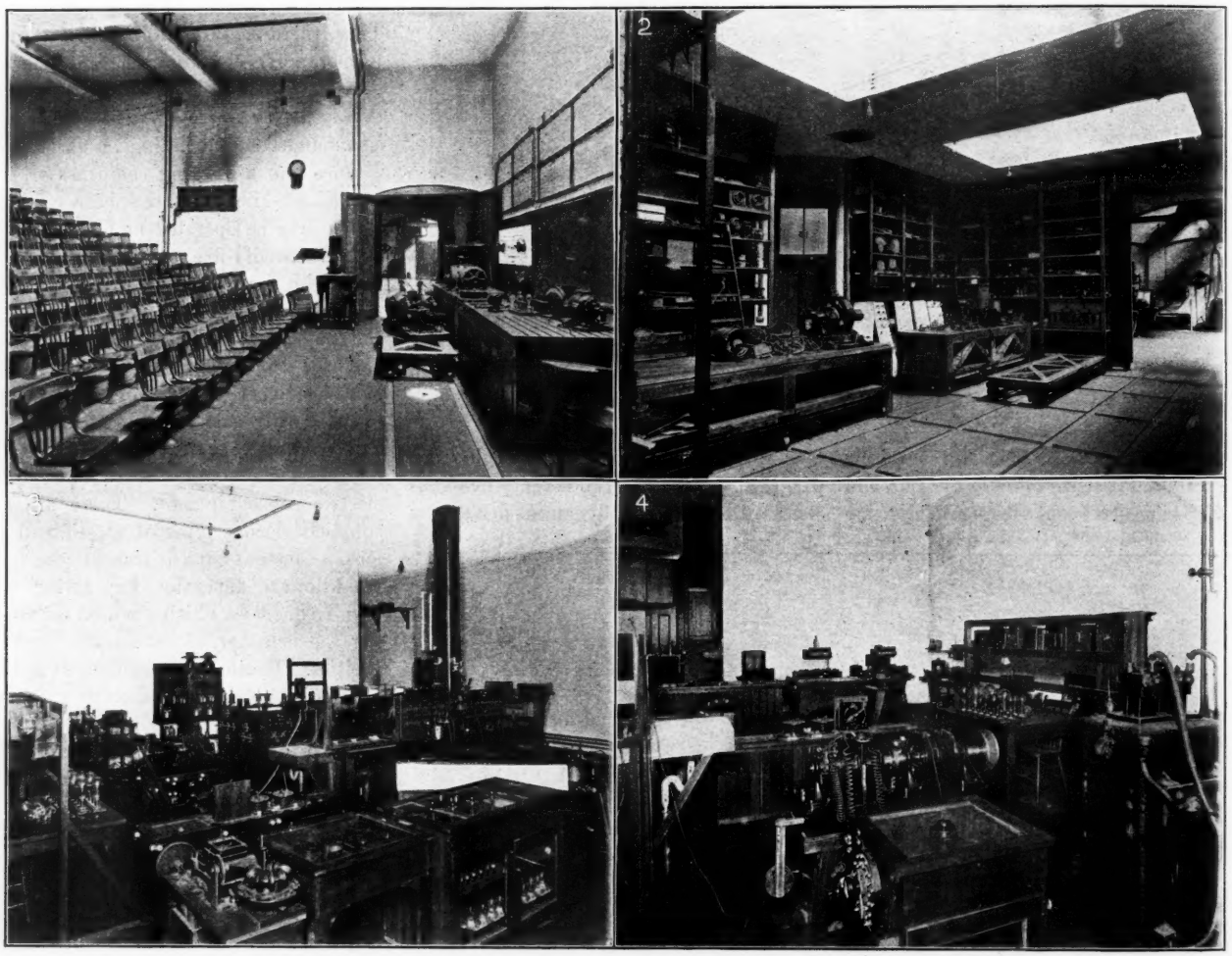
The two small rooms assigned to photometric study have been equipped, the one for measurement of incandescent lights and the other for the study of arc lights. The latter has a large photometer, designed and constructed by the institute particularly for this work.

In the lecture room, Fig. 9, special devices have been adopted to promote the comfort of the students and to assist the lecturer. This room seats 400, and is ventilated by means of air ducts delivering air under each row of seats. The lecture tables are mounted on casters and roll easily on the grooved rails shown. These rails pass through the lecture room and the adjoining preparation room into the dynamo laboratory, so that any of the small machines may be picked up by the crane, dropped on the truck, and rolled into the lecture room.

In the preparation room, shown in Fig. 10, there is a series of cross tracks, affording storage room for the tables not in use, and allowing the latter to be shifted about as desired. These testing tables are very strongly constructed, enabling the lecturer to mount a miniature generating station on them and operate it there. For this purpose there is a series of miniature switchboards suitable for any system of distribution, any one of which is easily mounted upon the table. The preparation room is well supplied with indicating apparatus, and a lantern for illustrative purposes.

This lecture room is used jointly by the department of electrical engineering and the department of chemistry, the latter having a preparation room similar to that described, but on the other side of the lecture room. The arrangement is such that all apparatus necessary for a lecture is arranged in the preparation room, and at the beginning of the lecture is wheeled into the room. It takes but a moment to connect up any source of electrical supply, or steam, gas, air or water. The lecture room may thus be used continuously, practically doubling its usefulness.

The work in the laboratories is conducted with an idea of making the stu-



FIGS. 7, 8, 9, 10.—AUGUSTUS LOWELL LABORATORIES, MASSACHUSETTS INSTITUTE OF TECHNOLOGY. 1—LECTURE ROOM. 2—PREPARATION ROOM. 3 AND 4—STANDARDIZING LABORATORIES.

dent think and act for himself. Self-reliance and resourcefulness are encouraged, the idea being to develop a man who can do things as well as know things. At the same time the experiments are laid out so as to supplement the classroom instruction and to illustrate the fundamental truths of electrical science.

The erection and equipment of this magnificent laboratory have enabled the Massachusetts Institute of Technology to open a graduate school of research. The object of this is to obtain a limited number of advanced men who can give two years to investigate some important problem in engineering. The work is of the highest type, and every facility for research is provided. There is a demand for engineers who can do more than keep abreast with the theory and practice of their profession. New questions are constantly being presented and must be answered, in order that the state of the art may advance. This is true in applied science as well as in pure science, and it is to meet this demand that the graduate school of engineering research has been opened. There are already a few students entered in this course, which was opened only at the beginning of the present academic year.

The Massachusetts Institute of Technology has always stood in the front rank of engineering schools. It is noted for the thoroughness of its instruction and for keeping abreast in its teaching with the engineering professions. The new electrical laboratory, which is second to none, is only a further proof of the determination that there shall be no lagging behind. The president of the institute is Dr. Henry S. Pritchett, and the head of the electrical engineering department is Dr. Louis Duncan, with whom are associated Professor William L. Puffer and Professor H. E. Clifford.

Verbs Needed.

The *St. James Gazette,* of London, thinks there is a need for certain new verbs. "We want," it says, "popular verbs for several operations introduced by modern science. The X-rays, the Finsen treatment for lupus, the operation of radium for cancer, and what not—what are the words for these? A man is guillotined or hanged; his leg is amputated; he is trepanned. What is it when he is rayed, Finsened, radiumed? We still want a wireless word. 'Marconigram,' which was suggested, seems to have died a natural death. What is the synonym for telephone when one speaks over the instrument to which a phonograph is attached? And have we finally agreed that 'motor' is the verb to travel by automobile?"

Mr. U. N. Bethell.

One of the most widely known and most successful telephone men of the day is Mr. Union Noble Bethell. His genius in the command of men and things has carried him to so many positions of eminence in the telephone field that his directive effort is now a prominent factor in the developing of telephony throughout the Middle Atlantic and the South Atlantic states.

Mr. Bethell was born in Evansville, Ind., and received his early education at Hanover College. He completed a course at the Columbia Law School, Washington, D. C., in 1885. Going West, he practised his profession in Minneapolis for some time. In 1889 he was engaged in the offices of the New York & New Jersey Telephone Company, of which company he soon became treasurer. In 1893 he became

MR. U. N. BETHELL.

general manager of the Metropolitan Telephone and Telegraph Company, which company was succeeded by the New York Telephone Company in June, 1896, and of this latter company Mr. Bethell is now vice-president and general manager.

Mr. Bethell was recently made president of the New York & New Jersey Telephone Company, and he is also president of the following companies: Bell Telephone Company, of Philadelphia; Delaware & Atlantic Telegraph and Telephone Company; Chesapeake & Potomac Telephone Company; Hudson River Telephone Company; Central New York Telephone and Telegraph Company; New York & Pennsylvania Telephone and Telegraph Company.

While it has been along the lines of organization and executive management that Mr. Bethell has achieved his greatest success, he has won an enviable reputation as a clear and forceful speaker upon many varied topics. Particularly so has this been the case when addressing the various legislative bodies before whom he has appeared, he possessing the ability to elucidate the knotty problems connected with modern telephone development and to lay before the uninitiated a simple exposition of this most difficult form of industrial traffic.

It is not alone with his own interests that Mr. Bethell has become popular, for he is held in high esteem by his business competitors, and his personal interest in thousands of employés of the companies which he represents has had much to do with the phenomenal success of all those institutions with which he has been or is connected.

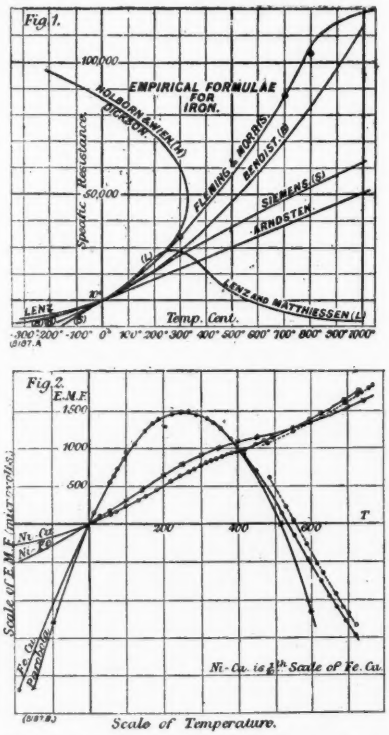
An Automobile Train.

The automobile as a means of hauling freight labors under several disadvantages. The wagon must itself be heavy, and when freight is added to this, the weight becomes so great that damage to the roads must result. If the freight be loaded upon wagons which are trailed by the motor car, nothing is gained, since the latter must be approximately as heavy as the loaded trailers in order to have the necessary tractive effect. Moreover, such trains are troublesome to control, because the trailing wagons do not follow in the tracks of the motor car, but tend to cut across at every curve. This becomes serious when there is more than one trailer to the train. To overcome these defects, an automobile train has been devised by Herr Renard. The motor is equipped with a powerful engine sufficient not only to drive it, but to drive also all the trailers. Running through this car is a shaft with flexible couplings, which, through gearing, drives the wheels of each trailer. In this way the necessary tractive effort is obtained without an excessive weight on any set of wheels. To prevent the trailing cars from turning too quickly, the tongue of each wagon is coupled to a rod projecting from the wagon ahead, the two being so proportioned that each trailer follows the track made by the motor car. A train made up in this way, with a motor car equipped with a sixty-horse-power engine, the car weighing fifteen kilogrammes, has successfully drawn a train of twenty tons along a road at a velocity of about twenty-five kilometres an hour. The train, which was easily handled, consisted of a motor car, two wagons for freight, and two carriages for passengers.—*Die Umschau (Frankfort a. M.), March 5.*

Electrical Methods of Measuring Temperature.

On Thursday, February 25, the first of a series of three lectures dealing with electrical methods of measuring temperature was delivered in the Royal Institution by Professor H. L. Callendar, F. R. S., whose platinum resistance thermometers are now coming into pretty extensive use in a number of different industries. The lecturer stated that there were two methods of measuring temperature by electric means—*viz.*, the change in the resistance of a wire with a variation in its temperature, and the electromotive force which is observed when heat is applied to the junction between two dissimilar metals. The first method had the advantage that the change to be measured was a large one, since the resistance of a coil of platinum wire at a high temperature was about five times as great as it was at the temperature of the room, and was thus a greater change than the change in volume of a perfect gas as compared at the same temperatures. Secondly, the resistance coil could be used to get the average temperature of a relatively large space, which was often convenient, as, for example, in taking the temperature of a gas. For this particular purpose a mercury thermometer had the drawback that its reading depended partly on radiation losses, which were 50 to 100 times as great as with the platinum thermometer. Coming to thermo-junctions, these were very convenient when it was required to know the temperature at a particular point, since the couple was affected by heat applied at the junction only, and not at all by heat applied elsewhere. The effect to be measured was, however, much smaller than the change of resistance in the other type, but for determining high temperatures, or great differences of temperature, the thermopile was excellent; though for measuring low temperatures or small temperature differences the electric-resistance thermometers were about 100 times as sensitive. In both types of thermometer platinum or platinum alloys were adopted as the material to which heat was to be applied, since there was then no trouble from zero errors due to repeated heatings and coolings, or to chemical action; while their infusibility was such that there was a very large range of temperature over which they could be used.

Both methods were sensitive and accurate, and could, moreover, be arranged so as to give their indications at any desired distance from the source of heat. Both were also well adapted for taking continuous temperature records either by photography, or by pen and ink, while mercury recording thermometers, on the other hand, were clumsy and slow. The calibration of electric thermometers was effected by comparing them with a gas thermometer. The change of electrical resistance was not exactly proportional to the temperature, but the law connecting the two had been established by a number of different experimenters. Between 0 degrees and 100 degrees centigrade the error made in assuming the resistance to be proportional to the temperature was about one-half degree centigrade, but at 400 degrees centigrade it was twenty-five degrees centigrade. It was found, however, that the resistance was a parabolic function of the temperature, and this was now found to be the case not only with platinum, but with other pure metals. A number of different empirical formulæ had been proposed for the resistance of iron at different temperatures, and were represented in Fig. 1. Between 0 degrees and 100 degrees centigrade they were all fairly correct, but as would be seen differed greatly at higher temperatures; and the experimental points plotted showed that, as with platinum, a simple parabolic formula fitted best into the results, holding right up to the temperature at which iron lost its magnetism. The recognition of this law simplified the calibration of a resistance thermometer, the constants of which were determined by heating the coil up to some known high temperature, such as the boiling point of sulphur.



FIGS. 1 AND 2.—ELECTRICAL METHODS OF MEASURING TEMPERATURE.

In making platinum resistance thermometers the wire was wound on thin mica plates which would withstand a high temperature, and had no chemical action on the metal. The resistance of the wire could be measured by a Wheatstone bridge or ordinary post office box, but, in using the latter, care must be taken to avert the usual connections of the battery and the galvanometer, which, while right for telegraph testing, were quite wrong for thermometric work, as too large a current then flowed through the galvanometer, heating up its coils and altering their resistance. Hence the galvanometer should be coupled up to the terminals usually marked B and the battery to those marked G. In order to avoid errors due to the change in the resistance of the leads between the thermometer coil and the Wheatstone bridge, two idle or compensating leads were taken from the other arm of the bridge up to the thermometer coil.

These idle leads formed a portion of one arm of the bridge, while the thermometer coil and the working leads made up the other. The compensating and working leads being exposed to the some changes of temperature automatically balanced each other. With platinum resistance thermometers there was, therefore, nothing equivalent to the "stem" errors which caused such trouble in making accurate measurements with mercury thermometers. Indeed the principal reason why the latter class of instrument was not used for high-temperature measurements arose from the magnitude of these stem errors, which might amount at furnace temperature to as much as fifty degrees centigrade.

The design of a satisfactory platinum recording thermometer had been difficult, since the currents which worked the relay mechanism actuating the inking pen were so extremely small, being roughly $\frac{1}{1000000}$ ampere, which is only about $\frac{1}{1000}$ of the strength of current used in ordinary land-line telegraph relays. He had found, however, that by letting the relay-arm make contact with a wheel continuously moved by clockwork instead of with a fixed contact, trouble from sticking was avoided, in spite of the extremely small force available for working the

relay-arm. Recording thermometers embodying this feature were now made for a variety of purposes, and were excellent as sunshine recorders. In these two thermometers were used, one of which was covered with black so as to absorb the light rays. The record obtained was much more instructive than that of the ordinary burning-glass recorder, since the intensity of the sunshine was not merely indicated but actually measured, and the instrument was, moreover, much more sensitive.

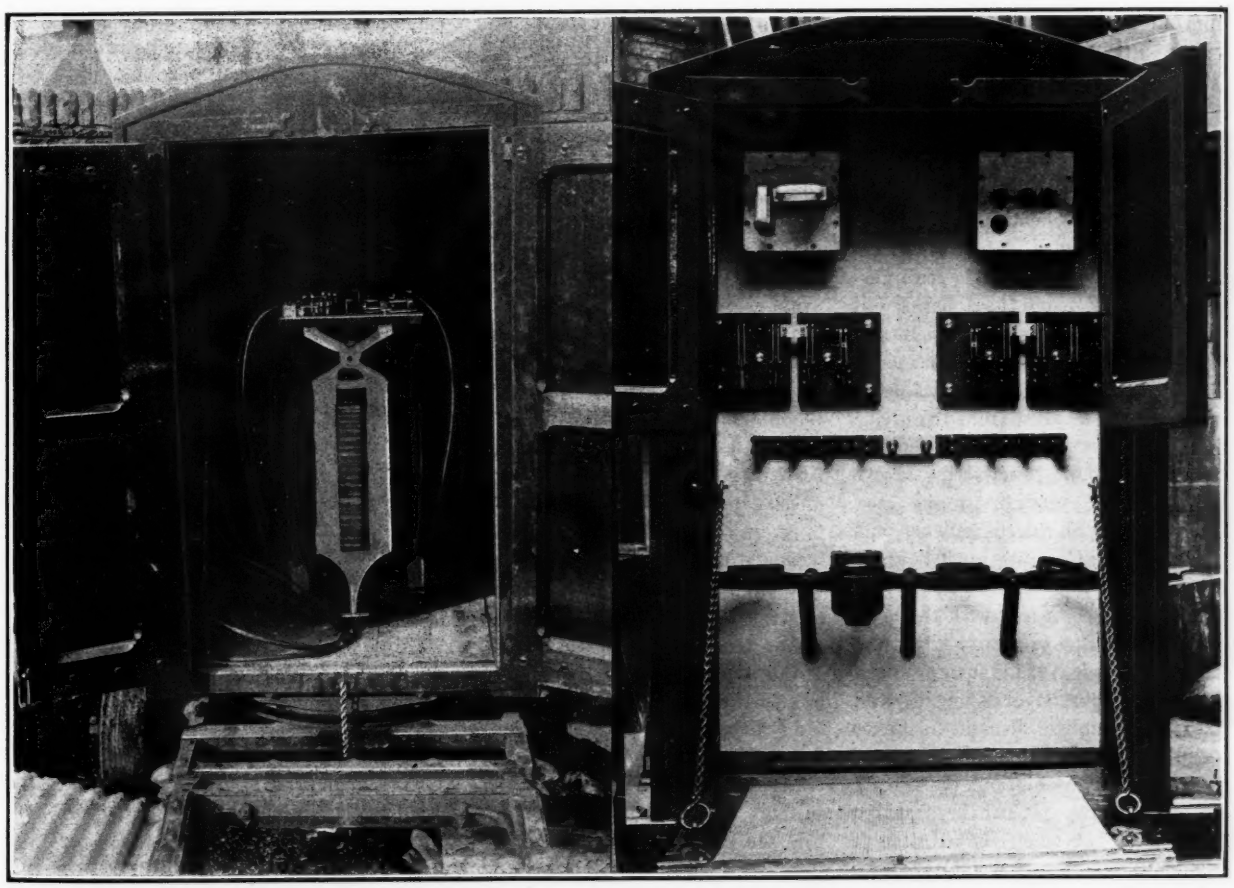
TRANSPORTABLE SUBSTATION.

BY A. STEANS.

The accompanying illustrations show the general appearance and details of a small substation mounted on wheels to permit of it being removed from place to place. The difficulty that has been experienced in complying with the demands of intending consumers is, that a considerable delay must take place before the current can be laid on, if the premises to be supplied are not immediately on the existing network. With the object as far as possible of overcoming this, Mr. S. E. Fedden, the general manager of the Sheffield (England) Corporation electric supply department, has designed and made a substantial van containing two fifty-kilowatt Burnaud transformers, and the necessary switch gear and cable connectors to enable a supply to be given immediately the high-tension mains are laid.

TRANSPORTABLE SUBSTATION CONTAINING TRANSFORMERS AND SWITCHING GEAR FOR EMERGENCY INSTALLATIONS.

The van can be drawn by two or three horses, according to the gradient, and left standing over the hole in the ground where the mains temporarily terminate, powerful brakes being supplied to the wheels and the harness gear removed to prevent any possibility of the van shifting. The ends of the cables are led up through a space in the bottom of the van and easily connected to clamps provided on the switch gear, which is arranged on a board in the back of the van. When the bottom door of the van is lowered, it constitutes a platform on which the operator can stand. At the top of the board are shown two high-tension fuse boxes controlling the high-tension feeders by means of oil or dust fuses. Connec-



VIEWS SHOWING INTERIOR OF VAN—TRANSFORMERS AND SWITCHING GEAR.

tion from these is made to the transformers inside the van, from the low-tension sides of which cables are laid to the low-tension gear shown in the middle of the board.

The equipment provides for rapidly joining up two high-tension feeders and four low-tension, the high-tension being lead-covered concentric cables, one for each phase, and the low-tension lead-covered four-core cables, two phases being conveyed in the one cable. Provision is made for securely locking the van and for ventilating it, and the whole arrangement has been found very useful to enable a supply to be given while permanent sub-stations are being built and fitted, on completion of which the cables are taken into them and the van moved to some other spot where its services are required. Such a device may also be used for temporary lighting, as on building works, exhibitions, etc.

Recent Advances in Electrochemistry.

The first of three Cantor lectures on electrochemistry was delivered by Mr. Bertram Blount on March 7. This lecture dealt only with the so-called "wet" processes, the speaker dwelling upon the refining of copper particularly. He called attention to the benefit of chemical and electrochemical competition in this field, pointing out that where no chemical process exists, the electrochemical process does not make much advance. The lecturer defined the terms "winning" and "refining." Metals are "won" from fused baths, but "refined" in aqueous solutions. The former process is usually conducted by means of a fused electrolyte, and is applicable to the separation of a metal from the ore.

In commenting upon copper refining methods, Mr. Blount believed the multiple system better, though, in any case, much depended upon the convenience, and after refinement great care must be exercised in working the metal. The power required is small compared with the labor item, and it was due to this fact that the American refiners had made such progress, as they have adopted labor-saving devices.

There is not much demand for pure zinc, and this metal can be produced in the pure state by distillation, though the process is expensive. It can be prepared electrolytically, but when the solution is slightly acid a high electromotive force is necessary, and if it be alkaline, the deposit of zinc is spongy.

Methods of obtaining nickel electrolytically are troublesome, and there are difficulties in separating it from its alloys. It would probably pay to make a copper-nickel alloy and deposit copper from this, recovering the nickel chemically.

A Quartz-Thread Vertical Force Magnetograph.

At a meeting of the British Physical Society on February 26, a paper was read by Dr. W. Watson on a "Quartz-Thread Vertical Force Magnetograph." The following is the official abstract:

The late Dr. Eschenhagen was the first to show that when the moment of inertia of the suspended system in a horizontal-force magnetograph is made very much smaller than that employed in the ordinary form, it is possible to detect variations in the earth's field of quick period. The design of a satisfactory form of instrument to record rapid variations of the vertical component presents very considerable difficulties. Thus if an attempt is made to reduce to any great extent the moment of inertia, and hence the mass of the balanced magnet in the ordinary form of Lloyd's balance, it is found that irregularities are immediately introduced owing to imperfections or dirt interfering with the free movements of the knife-edge. Further, slight tremors cause the knife-edge to slip about on the plane, and thus the azimuth of the magnet varies. The instrument which the author has designed and constructed resembles, in principle, the quartz-thread gravity balance of Professor Threlfall. In addition to the advantages derived from the suppression of the knife-edge, the instrument can be simply and accurately compensated for the effects of changes of temperature. The principle of the instrument is to have a magnet suspended on a horizontal quartz fibre kept stretched by means of a spring. The centre of gravity of the magnet and the torsion of the fibre are so adjusted that the axis of the magnet is horizontal. Any variation of the vertical force produces a rotation of the magnet about the fibre which can be suitably recorded by means of a mirror attached to the magnet. The temperature compensation is effected by weighting the magnet on the same side of the axis of the fibre as the south pole, so that the magnetic couple and the couple due to the torsion of the fibre act in the same direction. Hence, since an increase in temperature causes one of these couples to decrease and the other to increase, by suitably adjusting the weight, and therefore the magnitude of the torsion couple, complete compensation can be obtained. The suspended system in the instrument shown at the meeting consists of two magnets eight centimetres long and one millimetre diameter attached by means of small platinum straps to two fused rods of silica which form part of the plate of fused silica forming the mirror. The upper surface of the mirror is platinized. The fixed mirror is supported on the base of the instrument, and is capable of adjustment. The instrument has been tested at the National Physical Laboratory and it is proposed to set up one of the instruments in the new magnetic observatory.

Commercial Tests of Materials.

A paper was read recently before the Engineering Society, University College, London, by Mr. E. G. Izod, on "Commercial Tests of Materials." Emphasis was first laid upon the desirability of testing materials, in order that it might be determined whether or not they came up to specification, and also to determine the cheapest satisfactory material.

Testing materials and performing experimental work may be divided into two classes—that for the purpose of scientific research, and that for commercial purposes. It many respects the two classes differ a great deal. There are three rules which must be observed in making commercial tests: all tests must be made as nearly as possible under working conditions; the cost of the work must be kept down as much as possible, and the work must be so systematized that every test will follow a standard course from start to finish. A method of keeping a record of samples and tests was described, this being planned upon the card system.

Passing next to the work, the tensile test was taken up first, as this is the one most generally made. It was shown that the results given by this test may vary considerably if standard conditions are not adhered to, and the test may be useless for certain classes of materials. Thus, the elongation of a test piece depends upon the ratio of length to diameter, and for this reason all tests should be reduced to a standard. In place of tensile tests on cast iron, transverse tests were recommended, as it has been found that these give more reliable results. The shrinkage test was described, and its value in indicating the amount of silicon present pointed out.

The impact test for cast iron is a test for brittleness, which is an important factor. In actual failures the fracture seldom resembles that due to a tensile test, and for this reason other methods of testing are desirable. An advantage of the impact test is that it may be carried out by an unskilled operator on very small samples. The testing machine is self-adjusting. While the author believes that this method is still in the experimental stage, he considers the tests more reliable than tensile tests.

THE OPPORTUNITIES IN THE ELECTRICAL BUSINESS.[1]

BY GEORGE A. DAMON.

The electrical business is a complicated one, and is constantly undergoing changes. By the time a method or system becomes standard enough to be looked upon as a precedent, a tendency develops in some entirely new direction. The men who succeed in electrical work must therefore be quick to grasp the lessons of the past, must be ready to appreciate the limitations of the present and above all should be alert to seize the opportunities for improvement.

The leaders in the various branches of the industry during the first developments when electrical work was an art and not a science, were graduates from the well-known university of "Hard Knocks." The men of the second generation of workers who are now doing things are largely the product of a semi-scientific training in schools of technology, supplemented by experience of a practical nature picked up in a more or less haphazard way. A few years more will see the development of a third and better prepared generation of electrical experts, and it is safe to say that they will be the result of a combination of a practical training thoroughly mixed with a theoretical education. As it must be expected that the next generation will be superior to the present one, will it not be well to stop for an instant in the strenuous rush for results and make a few suggestions which may be of assistance to our successors in planning their life work?

"Work harder," "dig deeper," "put in a better cement foundation," are the keynotes of the suggestions which our older brothers give to us as the result of their experience, and the ambitious young man will be quick to recognize the value of their advice. But what is wanted most is some definite information as to how to spend the time devoted to preparation in the most efficient manner, and how to get the benefit of a combined training in theory and practice in the most effective way.

THREE ENQUIRIES.

That those who have traveled well on their way toward their goal have many opportunities to point the way to the ones behind, is well indicated by recounting several recent conversations. The first was with a boy of eighteen.

"I am a senior in the high school," he said, "and I want to become an electrical engineer; what shall I do?"

He was strong, bright, ambitious and willing to work.

"Some men tell me to take a college course first and enter practical work afterward; some tell me to get a few years' experience first and then take a college course, while still others tell me to study several years, work a year or two and then finish my senior year. In planning my course should I include the language studies or cut them out in favor of shop, laboratory or commercial courses? Should I try to get through in three years, or should I extend my college education over a period of five years? Others tell me to leave out the university work entirely, go to work in the shop or upon construction work, getting what theoretical training I require by attendance at night school or by taking a correspondence course. What shall I do?"

And there are some of us who will appreciate the young man's bewilderment.

The second conversation was with a professor at the head of the electrical department of one of our leading universities.

"I feel highly complimented," he said. "I have received a letter from one of the largest electrical manufacturing companies in this country, offering positions to my entire senior class. This is remarkable, for in Europe it is the custom for the technical graduates to pay for the privilege of entering the shops of the large companies. But," he continued, "I should like to find out whether or not I should advise my boys to accept this offer. What has become of the young college men who entered the shop courses in years gone by? Are they advancing as satisfactorily as the graduates who found positions in other parts of the field? Have the large companies taken care of the graduates of their testing departments with sufficient liberality to justify a young man in making the sacrifices which a shop course entails? Would it not be better all around if I offered the large company the services of my junior class for one year? What would you advise?"

The professor is to be commended in his search for information, and in his evident interest in seeing his "boys" get a fair start in the strenuous race in which they have entered.

The third conversation was with a young electrical engineer who had graduated from high school, had then taken a college course with some practical work during vacations, and had then entered a large factory as a "special apprentice."

"I have had a fine experience," he said, " and have nothing to regret. Upon leaving college I went into the testing department of a large electrical manufacturing company, was promoted rapidly, and finally advanced into the engineering department. My compensation at first was small, but it has gradually been increased until at the end of five years' service I am securing about $1,500 per year. I am looking out for the future, however, and am not entirely satisfied with the prospect. If I stay with my present employer, the manufacturing company, my work must be narrowed to one department of the work, and I will always be a salaried man without an opportunity to acquire an interest in the business. Would it not have been better for me to have started with a smaller company, and is it too late yet for me to begin over again? What would you suggest?"

Knowing that the leading electrical men of Chicago would afford a valuable field for studying results and would welcome an opportunity to help furnish a solution for the problems of the boy, the professor and the rising young electrical engineer, a letter of enquiry was sent to one hundred of the leading men in Chicago engaged in the various branches of the electrical industry. An opportunity was given at the same time for the expression of opinion on various questions pertinent to the general subject. The response to the circular letter was hearty and spontaneous, and we are under obligations to one hundred of our friends who have so kindly consented to become living examples, and willing to be analyzed for the good of the cause. The following is

AN ANALYSIS OF RESULTS.

Young men control the business. The enquiry was, therefore, confined to men between the ages of twenty-seven and forty-five, upon the theory that the older men are the product of a set of conditions, which have passed away, while the youngest men are, as a rule, still engaged in a period of preparation. The number of men of each age is shown graphically. The average age is thirty-three and one-half years.

The average income at each age is also plotted on a gunshot diagram and a line of average incomes determined up to the age of thirty-eight, after which there was not sufficient data to locate the curve. This income curve starts with a value of $2,170 at twenty-seven and extends to $4,000 at the age of thirty-eight. The average income of the entire one hundred men is $3,440 per year, which will give us a standard by which we can measure the different branches from a mercenary standpoint.

[1] Read before the Western Society of Engineers, Chicago, March 18.

The hundred men may be divided into groups as follows:

	No. of Men.	Average Age.	Average Income.
Salesmen	7	33	$2,400
Sales managers	11	36	3,400
Business men	10	36	4,800
Sales engineers	8	35	2,350
Electrical engineers	16	33	2,800
Constructing engineers	6	33	2,850
Electrical experts	8	33	3,200
Operating engineers	3	32	2,250
Operating managers and superintendents	10	34	3,550
Professors and editors	8	34	2,500
Patent attorneys	4	32	4,000
Consulting engineers	9	40	6,400

Total number of men, 100. General averages: age 33½ years; income, $3,440.

Classified in reference to incomes, the record is as follows:

	Men.
Income over $10,000 per year	5
Income between $5,000 and $10,000	9
Income between $2,400 and $5,000	66
Income below $2,400	20
Total	100

It should be stated that there are in Chicago at least one hundred more men in the business whose incomes will average about the same as the first hundred selected. An effort was made to make the list representative, and the men were selected on account of their positions without reference to their incomes.

It is to be understood that the dollar is not the most desirable standard by which to measure men individually, but looked upon as a class, a study of the averages furnished by the enquiry is interesting and may be made instructive.

Salesmen who have technical ability or possess engineering information, as a rule, get better salaries than those who do not.

Add initiative and executive ability to the salesman's ability and he becomes a sales manager with a still greater reward.

Enterprise and energy put the man in possession of his own business, or often result in a partnership arrangement. A technical man without the commercial instinct is only fairly well paid. Ability to develop new methods or apparatus puts him in the expert class where the rewards are greater and in proportion to his ability.

Routine work, such as operating, is the least remunerative work of all. Operating managers and superintendents, however, are very well paid.

The editors were classed with the professors as there were too few to form a class with an average of their own.

Our professors should form a union, as they are certainly entitled to higher compensation, and as we all appreciate their value we would help them win should they decide to strike. We must grant, however, that they get rewards in seeing the living results of their work, which is a compensation worthy of considerable sacrifice.

The phenomenal development along all electrical lines, and particularly in the telephone business, makes the profession of patent attorney a paying one for those who are qualified for that kind of work.

The field of consulting electrical engineering looks attractive, but it will be noted that the average age is greater in this branch than in the others, which means that the successful consulting engineer brings to his work years of experience, and that it is therefore not a branch to be adopted at once by the young man.

Forty per cent of the men in the list are employed by what might be termed the "large" companies, such as the Western Electric, Chicago Edison, Chicago Telephone Company, etc.

Thirty-five per cent of the men either control the business in which they are engaged or own a partnership interest.

Twenty-five per cent of the men are not college graduates.

Twenty per cent of this hundred successful men never had any college education whatever.

The average age of the twenty men who are succeeding without a college education is thirty-six years, and their success measured by a monetary standard shows an income of $3,670 per year.

The average age of sixteen graduates of Cornell is also thirty-six years, and their success measured by the same questionable standard is $4,940, which shows a balance of $1,270 per year in favor of a college education.

It will be noted, however, that the twenty men without the education are getting along financially slightly better than the general average of $3,440 per year. This is explained by the fact that in their number are included several men who are prospering as a result of their business enterprise.

There are few non-technical men engaged in the strictly technical end of the business who reach the average income.

There seems to be more openings for the man without a college training in the telephone field than in any other.

The enquiry into the domestic arrangements of our hundred examples shows that seventy-five per cent of them are married. The families are composed of forty-five boys and thirty girls.

Out of the hundred men selected only fifty-six per cent belong to the American Institute of Electrical Engineers.

The answers to the questions upon which an expression of opinion was asked resulted as follows:

Eighty per cent are inclined to think that a college education is essential to the highest success.

Seventy per cent are in favor of the technical graduate taking a shop course in a large manufacturing company, but many wished to limit this course to one year.

Fifty-five per cent are of the opinion that in choosing a life work better chances for advancement will be found with the smaller companies.

Seventy per cent are in favor of requiring a year's practical work of the student before graduation.

Fifty-five per cent agree that the larger companies would be consulting the interest of the art at large by offering an apprentice course open to students during an intermission of one or two years before completing the senior year.

The exact wording of the questions, to which some objection was made, and a number of instructive and qualified answers to each are given at length in the addenda. These opinions from men actually "doing things" are well worth careful study.

OPPORTUNITIES.

Each of the hundred men included in the enquiry were asked to name the three fields which he considered most promising within the immediate future and the votes received are as follows:

Electric railway work	63
Telephony	36
Transmission	30
Electrochemistry	29
Power applications	21
Lighting developments	12
Manufacturing	11
Central station work	9
Patent law	6
Consulting engineering	6
Contracting	5
Management of properties	5
Storage batteries	4
Reconstruction of plants	3
Mining	3
Metallurgy	3
Turbines	2
Wireless telegraphy, designing, high-speed telegraphy, undergr und conduit construction, isolated plants, train lighting and municipal lighting, each	1

As a result of personal observation, tempered somewhat by the opinions of the electrical men, with whom the questions have been discussed, the writer wishes to present the following conclusions:

A COLLEGE EDUCATION.

A young man wishing to succeed in any branch of electrical industries makes a serious mistake if he fails to use every effort to obtain a technical education. A college course is becoming easier to obtain and it is already recognized as a general requirement for advancement. A young man of high aspirations, who is so situated that he can not secure a university course, might better, nine times out of ten, take up some other branch of work which is less intricate than the electrical art. Thomas Edison, the dean of the profession, is not a college man, but a gold medal bearing his name is to

be given hereafter each year to the college graduate presenting the best thesis, and this incident is the best evidence of the present tendency toward technical education. Nearly every man who is now making his way in the electrical business without a college training, if asked what he would do if he had his life to live over will say: "I would secure a technical course in the best college I could find."

CORRESPONDENCE SCHOOLS.

A technical course in a correspondence school which can give the proper training for an electrical engineer is yet to be produced. The correspondence schools are doing a good work and are to be recommended to those who can not possibly avail themselves of a college course or get instruction in evening school, courses such as offered by Armour or Lewis institutes, but a young man who will deliberately choose correspondence instruction if anything else is available is making a serious mistake. Of the hundred men in the list only two had completed a correspondence course. These two men were engaged in telephone work, and both voted in favor of a college course.

PRACTICAL EXPERIENCE.

Practical experience is as essential as theoretical training. Too little attention has been paid by students in getting into thorough contact with the way things are actually done. This is the result of the general practice of allowing the young man to shift for himself. "I can't get a job without experience," he says, "and I can't get experience without a job;" and then, more or less discouraged at the outlook, he takes the first opening which presents itself, and it may or may not be the kind of work for which he is fitted. What is needed is a general clearing-house of information, a closer union between the ambitious student and the successful men who have been pioneers in the work. The electrical business has now progressed far enough that the actual experience essential for the highest success along any one of its various lines can be generally indicated by experts familiar with the ground to be covered. It is time, therefore, to abandon a thoughtless and perhaps selfish attitude toward the beginner and make some organized effort to map out the territory which he must travel with guide posts and signs marked: "This way to the front."

An association of thoroughly successful men should exercise some supervision over the preparation of the coming generation. If it is true that the art is suffering today from lack of trained men ready to take up and solve the problems which are all about us, what must we expect of the morrow with its widening opportunities? The student branches of the American Institute of Electrical Engineers and the recently formed Edison Medal Association are moves in the right direction, but only a beginning toward realizing the possibilities. Considerable attention is being give to develop the best technical course, but a college training is less than half of an education. What constitutes the other half is a big problem waiting for a comprehensive answer.

SHOP COURSE.

The policy of the large companies in offering apprentice courses and opportunities for experience in their testing departments is to be commended. This practice, as carried on in some cases, however, is to be criticised. A representative of a large manufacturing company visits a technical school, offering to give positions to all the members of the senior class; the professor is highly complimented at this remarkable courtesy, and advises his students to accept. The "shop" course usually covers a period of two years. The hours are long and the pay is small. The "experience" gained by the student may or may not justify the sacrifice. "It depends largely on the man." In the meantime the large company has a good opportunity to select the material which it requires for its own use, and perhaps twenty-five per cent of the shop graduates have reason to feel enthusiastic over the system; the others pass through days and nights of discouragement, and many leave the shop with a sense of failure, which is sure to have an influence on their future.

All men are not built alike. Then why grind them through the same mill? Should not some selections of materials be made before the mills are started, a sorting over made earlier in the process? Perhaps the mills themselves could be made a little more efficient. It does seem possible that a commission made up of the broadest men in the profession, some from the large companies and some from outside practice, could do much toward improving the facilities and present systems for "getting experience." On behalf of the students now in the colleges who have still to face the practical problems, an appeal for help, information and suggestions is made.

THE STUDENT'S PART.

The trouble with a great many young men is that they don't "find" themselves early enough in life. They fail to realize the possibilities and are not prepared to grasp their opportunities. Ambition, aptitude, preparation and hard work are the stepping-stones to successful attainment. Let the ambition to excel be deeply seated and directed along the line of natural endowment; let the purpose be firm, and as day follows night the preparation will be thorough and the man will be known by his works. "If I had it to do over again I would pick out some definite line of work suited to my talents and work like fury" is the advice of many successful and even unsuccessful men.

The purpose of this paper is to encourage a general discussion, which may be of some help in arousing the latent ambitions of the young men who have not selected their life work, by showing them the boundless opportunities of an undeveloped science; to encourage the efforts of the students in our colleges by presenting the results which have been attained by their predecessors; to crystalize the sentiment in favor of a scientific combination of theory and practice, and finally, to give an opportunity to the men on the fighting line to point the way to their successors who must come to the front prepared in every way, if they intend to take some part in the phenomenal developments which are to be expected.

In order to direct the discussion along definite channels the following is offered as a suggestion to a young man seriously considering engaging in the electrical business:

A SPECIFICATION FOR SUCCESS.

In General—The purport and intent of this specification is to cover the labor and material required to produce in complete working order a man prepared to attain his own ideal of success in that branch of electrical work which he may elect.

It is to be understood that the omission of the mention of small details in this description does not obviate the necessity of their being furnished. What is wanted is a thoroughly trained, well seasoned, broad minded man, complete with an individual character, a strong intellect, and a sincere purpose.

Plans—He will form his ambition early in life.

He will take a natural interest in the history of men of eminence in his chosen work and their achievements will inspire him with a desire to accomplish great things.

He will develop his imagination and constantly broaden his conception of his own possibilities.

He will seek to learn what the world wants and then will endeavor to train his natural abilities so as to supply that want.

Foundations—He will as a boy develop a knack of "doing things" either as a mechanic, as a draughtsman, or in some boyish business enterprise, and a combination of any two or all three proclivities is desirable.

He must early learn the advantage of doing some one thing well, but he should not allow praise for his proficiency to encourage him to neglect study along the lines he does not naturally fancy.

He will prepare for college and during this period of preparation he will get enough experience in practical work to demonstrate that he has made a wise choice for his life work.

He will not let the attractions of practical work interfere with his intentions to secure the best theoretical and technical training the country affords.

Dimensions—He will endeavor early to "earn money" by doing useful work, and will seek employment outside of his study hours. Everything he attempts he will complete to the best of his knowledge and ability.

He will put himself on a self-supporting basis as soon as possible, and will earn his own way through college. If he receives financial assistance, he will treat it as borrowed money, to be returned, and he will keep the debt within reasonable limits.

He will not allow any false sentiment "to finish with his class" prevent him from stopping out one or even two years during his college course to add to his store of practical experience among electrical or allied lines.

He will determine for himself whether he intends to realize on his possibilities quickly or whether he will lay a broader foundation for a slower but higher development.

General Design—Each bidder will state the percentage which he is prepared to guarantee in connection with the following qualities:

Health	Patience
Ambition	Cheerfulness
Honesty	Self-respect
Truthfulness	Self-reliance
Temperance	Courage
Self-control	Observation
Decision	Initiative
Purpose	Enterprise
Up-to-dateness	Enthusiasm
Originality	Concentration
Energy	Executive ability
Common sense	Scholarship
Industry	Despatch
Tact	Punctuality
Grit	Stick-to-itiveness
Thoroughness	Judgment
Neatness	Good manners
System	Capacity for hard work

Consideration will be given to guarantees of high efficiency of each item. It is suggested that all of these qualities be carefully measured.

Capacity—Even if the young man possesses only ordinary talents, his capacity for hard, conscientious, intelligent, well-directed work will attract attention and win advancement.

When the occasion demands he will be able to stand a long run on overload or respond to excessive demands for short periods without permanent injury.

He will be able to direct others and will not depend entirely upon his unaided efforts for results.

Operation—He will work quietly, and will be turning in the right direction every minute in a simple, direct and accurate way.

He will join that great army of workers who are actually doing things rather than that smaller class of men who occupy most of their time in telling what they are going to do.

Parallel Operation—As a student he will enroll as a member of the student branch of the American Institute of Electrical Engineers and take a lively interest in the Institute papers and discussions. In practice he will advance to associate membership and will look forward to the day when he has added sufficient to the art to be considered worthy of active membership.

If he locates in Chicago or in the West he will become a working member of the electrical section of the Western Society of Engineers.

He will make friends among his superiors, who will respect his ambitions and will be glad to assist him in realizing his ideals.

He will study men and know how to deal with them.

Work to Be Done by Others—Parents should study their children and encourage them to develop their natural tendencies.

Teachers should get hold of their students personally and as far as possible treat each case individually.

More occasions should be made for successful men to meet students and give them the benefit of their advice and experience.

The students should not be isolated in a little world of their own, but should be brought in contact with an atmosphere of actual affairs.

Above all, some method must be devised to guide the young man to and through the course of practical experience best adapted to his qualifications and purpose in life.

Shop Tests—If he enters the shop or testing department of a manufacturing company, he will make a bargain which will result in his getting an all around experience in exchange for his services, and, while in the shop, will keep on the move in every sense of the word.

He will seek to make himself thoroughly practical in all his ideas and methods of work.

Finish—He will include in his preparations considerable literary work and will seek after a general culture. He will study at least one foreign language.

He will regard his college work as only the beginning of his education and will be a student always.

He will seek practice in the art of expressing himself, and will occasionally write a paper on some technical subject.

He will become interested in some social, educational or reform movement, and will avoid becoming a recluse interested only in his own work.

Inspection—During his senior year he will submit a thesis in competition for the Edison Medal and even if he fails to get the prize his effort will demonstrate his sincerity and will show the thoroughness and breadth of his preparations.

Fittings—He will find it necessary to possess accurate knowledge of nearly every branch of science, including physics, chemistry, mathematics, mechanics, pneumatics, hydraulics, mining, metallurgy, and civil engineering.

He must know something about accounts and a great deal about business and commercial law.

He will find that the electrical business is so broad in its scope that a natural aptitude in any direction can be made of use.

Completion—He will make every sacrifice to get a thorough preparation and a broad experience up to the age of twenty-eight or thirty years.

He will accomplish much between the age of thirty and forty-five, at the end of which time he will be well settled in his business or profession.

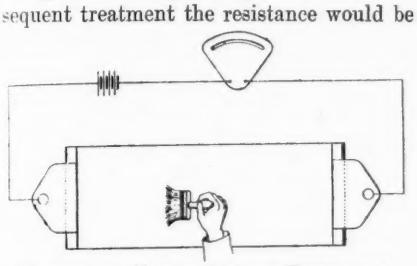
Let us leave him at this time to inherit his own. May he live long and prosper.

The National Electric Light Association.

The National Electric Light Association has published a list of preliminary questions for the question box of the twenty-seventh convention, which will be held in Boston, Mass., May 24, 25 and 26. This list is nearly twice as large as the completed list for last year's convention, and there is every indication that the question box for the coming convention will not only be the largest, but the most systematic and comprehensive ever presented by the association. The list, as published, is divided into twenty-three departments, and in each department there are from one to fifty questions.

Electrical Patents.

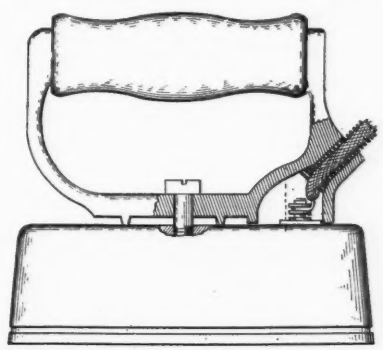
George L. Leonard, of Pasadena, Cal., is the inventor of a carbon resistance and method of producing and adjusting it. A sheet or core plate is provided, desirably of asbestos or similar insulating refractory material, is coated, preferably from end to end on both faces with plumbago or carbon, the thickness of each coating being made so slight that without the subsequent treatment the resistance would be



Method of Making Carbon Resistance.

higher than required. The plumbago is desirably applied in the state of a paint or paste with water and sufficient sugar or similar binder to cause it to adhere to the support, and it may be applied with a brush or similar means. After the plumbago coating is dry or nearly so it is ready for treatment according to the present method to control or adjust its resistance. The terminal strips first having been fastened on the ends of the resistance element, the latter is connected by means of terminals in the electric circuit with the battery and ammeter, and the deflection of the ammeter will show the conductivity of the resistance element, which for the purpose of adjustment will be considerably lower than required in the final product. Then by means of any suitable implement, such as a brush, or a scraper, or roller, or any object which will produce a requisite polishing and compacting effect, the coating of plumbago is subjected to frictional or rubbing pressure, and thereby measurably compacted or polished, which effects an increase in the conductivity of the coating, as will be indicated by the increased deflection of the ammeter. If the supporting sheet is coated on both sides, it is desirable to rub one side only enough to bring the conductivity part way up to the desired amount, the resistance element being then inverted and the other side rubbed until the resistance is lowered to the required standard, as shown by the ammeter. The resistance element may then be removed from the clamps and inserted in a rheostat, and it will be found that the increased conductivity imparted to it will be substantially permanent. The process therefore affords a means of accurately controlling the resistance of the rheostat element, as the rubbing may be stopped just as soon as the ammeter shows that the proper resistance has been reached. Inasmuch as the coating or coatings will be much thinner than if they are simply laid on wet and then dried and used without this special treatment, it follows that less plumbago will suffice, and the coating will adhere more strongly and be less apt to flake off. Moreover, the heat generated in the coating will be more readily conducted away and thrown off, as the layer it has to pass through is thinner and also a better conductor of heat.

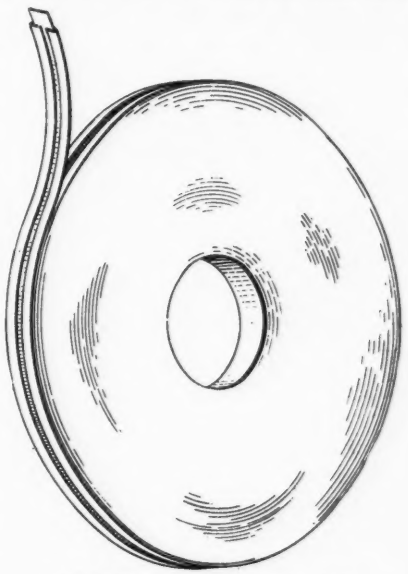
Mr. George J. Schneider, of Detroit, Mich., is the inventor of an improvement in electric sad-irons, which he has assigned to the American Electrical Heater Company, of Detroit, Mich. In the embodiment of the invention, a body of iron is employed in which is arranged an electric heater. The handle of the iron comprises a bifurcated bracket, between the furcations of which the handle proper is secured. This bracket is attached to the body of the iron by means of a screw, which passes through the central aperture in the bracket and engages with the threaded aperture in the body. The terminals of the electric heater are formed by two binding-posts, projecting upwardly from the body of the iron, near one end thereof and adjacent to each other. To these binding-posts are attached insulated electric conductors, which joined form a common cord. These connections are protected from injury by being enclosed within a housing which is formed integral with the bracket.



Electric Sad-Iron.

The housing is formed by a hollow enlargement in the bracket which is open at the bottom and is arranged to enclose the binding-posts and the connecting conductors. At the upper end of this housing is a projecting boss, centrally apertured for the passage of a cord. A flexible resilient tube secured wthin the boss end and projecting upward therefrom is preferably formed by a helical spring, and in order to secure it within the boss end the inner end of the helix is slightly enlarged. Thus the tube may be inserted in the aperture from the inner end thereof, and when in position the enlarged end will prevent the disengagement of the spring. This tube protects the cord from short bends or kinks, which might result in breaking the electric conductors.

Varley Duplex Magnet Company is the assignee of a patent recently obtained by James C. Anderson, of Jersey City, N. J., on an electrical conductor and coil. This conductor is of copper or any of the metals commonly used for the purpose. It is insulated by an envelope of paper which is applied to the wire in the form of a



Electrical Conductor and Coil.

strip, having its lateral edges bent over the lateral edges of the wire and approaching each other more or less nearly and forming a longitudinal seam along one face of the wire. The paper may be caused to retain itself upon the wire sufficiently to enable it to be handled or be passed through a winding machine to coil it up for electrical coils. No adhesive material is used to secure the paper to the wire. The wire can be wound into electrical coils in any desired manner, but the specific coil invented by Mr. Anderson consists of a spiral, the convolutions of which are all in the same plane at right angles to the axis. The spiral is formed by winding the wire with the seam of the insulation on the convex side, so that the curvature will draw the abutting edges of the insulation tightly against the face of the wire. This produces a smooth even winding, whereas if the wire is so wound that the seam comes on the concave side there will be a tendency of the paper to wrinkle or buckle and produce irregularities in the winding. The open space at the seam may vary in width, so long as the edges of the wire are well covered or lapped. The winding operation brings the continuous or closed portion of the insulating cover of one convolution against the seam of the next, thus thoroughly insulating the two convolutions and mechanically securing the edges of the seam in place.

Reviews of Current Engineering and Scientific Literature.

Electrical Fires.

Recently smoke was noticed coming from a substation near London. The fire department responded to the alarm and quickly flooded the place, making matters worse, not only for the substation, but for the power station as well. To meet such emergencies, Mr. E. Kilburn Scott says: "It looks as though special fire engines are required, which would throw a jet of sand in place of water." He suggests that it might be advantageous to have a large tank of sand on the roof above the switchboard, with a flexible hose, so that the sand could be instantly turned on to a short-circuit. Another point considered is the dense and suffocating smoke given off by many kinds of insulation when set on fire. This is particularly the case with rubber, and it seems as though it would be better to use only bare wire for switchboard connections, or, at least, to adopt some kind of insulation which would be less objectionable than rubber. The same point is made against the use of linoleum or rubber mats covering the floor of the switchboard gallery. If insulation is necessary, the floor should be of glass or slate.—*Abstracted from the Electrical Review (London), March* 4.

A Method for the Determination of Coefficients of Mutual Induction.

A simple method of determining coefficients of mutual induction is here described by Mr. A. Trowbridge. In this method comparison is made with a self-induction, which may be separately determined. Two coils joined in series, with the windings in the same direction, are equivalent to a single coil of self-induction equal to the sum of the two coefficients of self-induction, increased by twice the coefficient of mutual induction. If the coils are joined in series so that they oppose each other, the system is equivalent to a single self-inductance equal to the sum of the coefficients of self-induction diminished by twice the coefficient of mutual induction. To make the measurement, two coils—one provided with a reversing switch—are placed in one branch of a Wheatstone bridge, the other branches of which contain a non-inductive resistance and a variable standard of self-induction. A balance is first obtained with the coils acting together, and then with them in opposition. The mutual inductance of the two coils is then equal to one-quarter of the difference between the values of the standard of self-inductance for the two determinations. If a variable standard of self-induction is not available, a coil having a fixed self-inductance may be used, but the work is more tedious.—*Abstracted from the Physical Review (Lancaster, Pa.), March.*

The Blondlot N-Rays.

Mr. A. A. Campbell Swinton has repeated some of M. Blondlot's experiments and has observed the effects the latter describes, but in each case he attributes them to heat. For instance, a coin taken from the pocket and laid at the back of a calcium sulphide screen will, in a few seconds, show through the screen as a disc of increased luminosity, the effect being due to the warmth of the coin. Or if two calcium sulphide screens are placed upon two pieces of similar metal, differing in temperature only about two degrees Fahrenheit, it is easy to discover which of the two metals is the warmer by the superior luminosity of the screen placed upon it. He has obtained the same effect when placing a screen upon his boot, as described by Blondlot, but he also got the same result when his foot was not in the boot, if the latter were warm. He has obtained impressions on sensitive paper through several thicknesses of black paper when exposed to a high-power Nernst lamp, but the black paper became perceptibly warm to the touch. The author believes that the increase of luminosity, due to a Nernst lamp or an Auer burner, is caused by radiated heat. However, he hesitates at questioning the work of M. Blondlot, and suggests that the latter may have obtained certain phenomena visible only to certain individuals.—*Abstracted from Nature (London), March* 3.

Improvements in Steam Turbines.

Two constructional faults are frequently charged against the steam turbine. One is the loss caused by leakage through the clearing spaces between the guide vanes and the revolving part; and the other is the expense of construction and the risk of breakdowns through failure of the revolving rings. To overcome, as far as possible, these defects, Mr. H. Davie and Mr. F. Hodgkinson have each brought out a new turbine. The former uses a cylindrical rotor, upon which sets of blades are slipped, increasing in size successively. The guide-rings have a similar construction, and slip into the case. The guide-rings and blade-rings are hollow, the inner space forming a receiving chamber, and the two faces acting in the one case as guides, and in the other case as blades. The construction aims to give a fairly long passage around the blades and guides, and to allow the moving ring to be set close to the stationary ring. With Mr. Hodgkinson's turbine, steam is admitted centrally, passing along the shaft both ways through the rotor. Upon the rotor are rings formed of fairly large blades. Between the sets of blades are fixed rings which are perforated with openings, forming nozzles. These first contract in the direction of the passage of the steam, and then expand. They are so proportioned that the jet of steam is considerably smaller in size than the blade upon which it impinges. To prevent leakage around the guides, the latter are formed with a series of projecting flanges fitting into corresponding channels in the rotor, and thus forming a long, narrow passage which obstructs the leakage of steam.—*Abstracted from the Mechanical Engineer (London), March* 5.

Hydroelectric Installation at Newry, England.

The interesting description of a small English power plant shows how low heads with variable rates of discharge may be utilized. The site is that of an old discarded dam and mill-race. The dam was in good condition, except for a few leaks. It is 167 feet long, giving a maximum head of six feet. The canal might have been utilized, but this would have caused a loss in head, and the upkeep of the canal would have been rather expensive. It was decided it would be cheaper to install an electric plant at the dam, so as to make use of the entire head of water, and transmit the power to the mill, which is only a quarter of a mile distant. As there is no storage capacity, the flow of water varies greatly and rapidly. The increase in flow above the normal increases the available power up to a certain point, where the decrease in the head more than balances the increase in flow. Thus, when three inches of water were passing over the dam, the actual fall was six feet. With eighteen inches of water going over, the head had dropped to three feet. From a study of

the problem it was found that when the height over the weir was 19.8, the maximum, or 354 horse-power, was obtained. The output which could be depended upon was only fifty horse-power, and a fifty-horse-power turbine with an efficiency of seventy-six per cent, utilizing at full load a supply of 6,200 cubic feet of water per minute, under an effective head of five feet six inches, was installed. This is belted through a countershaft to a thirty-kilowatt generator. As the plant must take care of itself much of the time, automatic governing was resorted to. Two rotary oil pumps, driven from the countershaft by a belt, control the opening of the gates and maintain the speed constant at 300 revolutions per minute. The dynamo runs at 650 revolutions per minute, and has an output of 130 amperes at 230 volts. It is a compound-wound machine with an overload capacity of twenty-five per cent. The line loss is 7.2 per cent, so that, allowing ten per cent loss in the countershaft and belts, fifty-seven per cent of the theoretical energy of the falling water is delivered to the distributing board at the mill.—*Abstracted from Engineering (London), March 4.*

Two Large Water Power Installations.

Two new generating stations in Switzerland—one at Hauterive and the other at Montbovon—are here described by Signor Enrico Bignami. The equipments of the two are practically the same. The Hauterive plant, which is controlled by the state authorities, derives its power from the river Sarine. The maximum output of the installation is 9,000 horse-power, and the minimum 6,000 horse-power. The effective fall is about 200 feet. From the dam, which is 209 feet long, 29 feet wide and 26 feet high, the water is carried by means of a canal and tunnel one and one-third miles in length, with a cross-section of fifty square feet. The equipment consists of ten alternators of the vertical type, placed directly on the shafts of the turbines. They run at 300 revolutions per minute. The efficiency of the turbines is guaranteed to be seventy-five per cent, and the speed variation under normal full load will not be more than one per cent. The sudden throwing off of full load causes a variation of three per cent only. The alternators are rated at 950 kilowatts and deliver current at fifty cycles per second, 8,600 volts. Each alternator weighs about forty-three tons, the revolving field weighing thirteen and one-half tons. The generating station is a large rectangle divided into two sections. One of these contains the generating machinery, and the other, which is divided into several floors, contains the cables and measuring instruments. The line wires are carried out on two towers, one placed at each end of the building. Each unit is as independent as possible, every exciter having its own switchboard and every alternator a special separate switch chamber in which is located all the controlling apparatus. The main bus-bars are of aluminum, arranged in duplicate, with sectionizing switches. The Montbovon station, which is associated with the Hauterive station, is also on the Sarine river. The capacity of this station is 5,600 horse-power. There is a double set of leads between the alternators and the switchboards. The lines are protected by lightning arresters with a water resistance. The district supplied from these stations is almost wholly agricultural, and the energy is mostly used for lighting and for motors employed in certain tile works, sawmills and workshops. Power is also supplied for several electric railways.—*Abstracted from the Electrical Magazine (London), February.*

The Early History of the Mariners' Compass, and the Earliest Knowledge of the Magnetic Declination According to Bertelli.

As early as 1866 Signor P. Timoteo Bertelli began the study of the origin and early history of the mariners' compass. In this article Mr. D. L. Hazard gives a brief review of Bertelli's work, and the conclusions which were drawn. A careful examination of Greek and Latin authorities, covering the period from the sixth century B. C. to the tenth century A. D., failed to find any mention of the directive property of the lodestone or any suggestion from which one might conclude that this directive property was used either in navigation, astronomy or surveying during that period of time. On the other hand, that the directive property of the magnet was known to the Chinese before the beginning of the Christian era is proved by repeated descriptions of the so-called south-pointing charts, the distinctive feature of which was a doll attached to a magnet and mounted on a pivot, so that an outstretched arm was always directed toward the south. There is also mention of a rude compass with a floating needle, used on Chinese ships, but as they had no sea-going commerce, there was no necessity of improving upon this type. It seems probable that the Amalfians, who engaged in commerce with the east, brought home one of these crude compasses and substituted the pivoted needle for the floating one, adding the graduated card or "Rose of the Winds." The first European writer to mention the primitive compass with the floating needle was the English monk Neckam, toward the end of the fifth century. Bertelli denies that the compass was perfected at Amalfi, Italy, and holds that there is no foundation for the tradition ascribing the invention and improvement of the compass to Flavio, at about the beginning of the fourteenth century. Some writers believe that the Chinese knew that the compass did not point exactly to the pole of the heavens, in evidence of which they cite passages in Chinese works, mentioning a declination from the true south. Bertelli believes that they ascribed this declination to the method of suspension—a thread of cotton being used—and not to the true magnetic declination. This view is supported by the experience of the Jesuit mathematician, in the seventeenth century, who had considerable difficulty in convincing the Chinese mathematicians that there was a true declination. Were the early Chinese writers aware of this, the fact would certainly have been known to the Chinese scientists at that time.—*Abstracted from Terrestrial Magnetism and Atmospheric Electricity (Baltimore), December.*

BOOK REVIEW.

"X-Rays Simply Explained." R. P. Howgrave-Graham. London. Percival Marshall & Company. Paper. 93 pages. 5 by 7 inches. Illustrated. Supplied by the ELECTRICAL REVIEW at 25 cents.

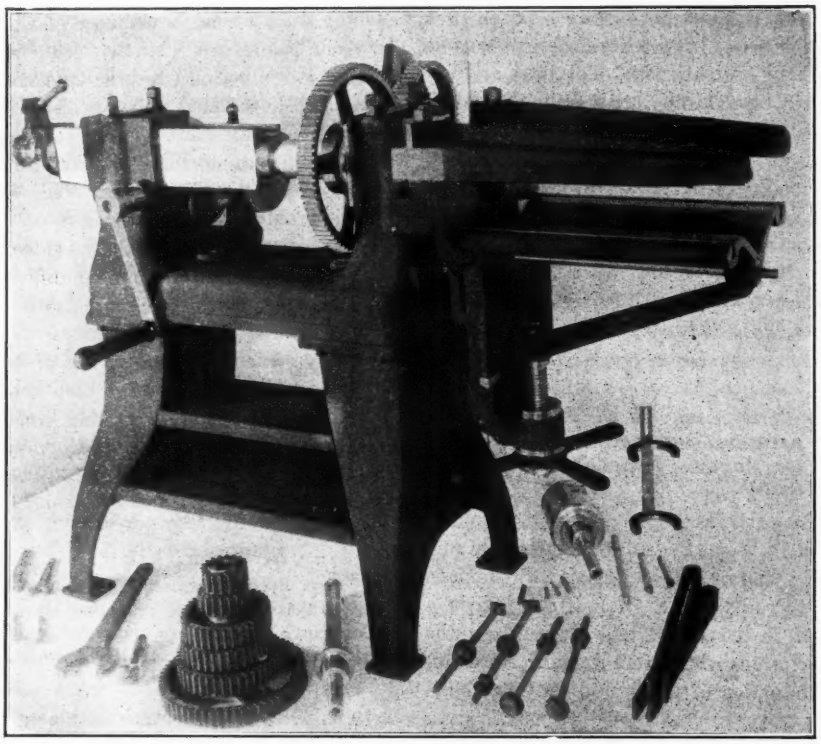
In this little handbook the author gives a clear and concise account of the sequence of experiments, discoveries and improvements which have led to the present knowledge of Rœntgen rays and their application to pathology. This book is intended especially for students and amateurs, but will probably be found useful by the practising physician. The behavior of the exhausted tube when a current of electricity is passed through it is described, with particular reference to the modifications and types found useful in Rœntgen-ray work. Instruction is given for constructing an apparatus for producing suitable discharges, the tube itself is described in detail, suggestions are given for operating and caring for it, the necessary accessories are explained, and directions for the use of the tube in preparing plates are included.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

A New Oil Grooving Machine.

The Garvin Machine Company, Spring and Varick streets, New York city, is placing on the market a new type of oil grooving machine. This is a simple and convenient hand machine for cutting oil channels in bronze boxes, bushings, etc., instead of chipping. The cutter bar is reciprocated by crank and rack pinion, and at the same time gearing is provided to rotate the cutter bar so as to cut either a right-hand or left-hand spiral groove within the length of the box. Change gears are provided for different spirals, and an index table is furnished. The work is clamped on the knee, which has a vertical screw adjustment.



A NEW OIL GROOVING MACHINE.

A small knob at the rear of the cutter bar feeds the tool point at each stroke. Solid or half boxes, with straight or taper holes, can be grooved, and the machine is made in two sizes.

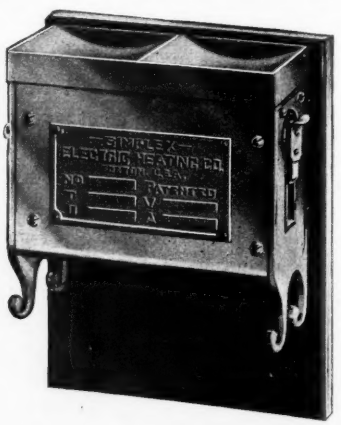
The World's Copper Production.

Figures showing the world's copper production since 1880 have been compiled by Mr. W. J. Ballrad. The production for 1903 was 589,361 tons. For 1902 it was 551,316 tons, and for 1880 it was only 153,959 tons. Of the total output for 1903, the United States produced 318,861 tons, Spain and Portugal coming next with 51,000 tons, followed closely by Mexico with 48,000 tons. Japan and Italy produced 31,000 and 30,000 tons, respectively; Australasia, 29,000; Canada and Germany about 22,000, and 37,000 tons were secured from various sources. In every case there was an increase over the previous year, though, except in the cases of the United States, Mexico and Canada, the increases were small.

Electric Heater Novelty.

The effort to reduce theatre hazards to the minimum on the part of owners, managers and insurance companies has made a demand for electric curling iron and grease-paint heaters so as to enable gas to be eliminated from stage dressing rooms. In addition to its previous product in this line, the Simplex Electric Heating Company has recently brought out a new type of combined grease paint and curling iron heater listed as No. 1283. While it is a combination device, the heating of the grease paint is independently controlled.

The grease-paint heater is divided in two sections and forms the top of the device and is controlled by a quick opening switch on the left side of the device. The curling iron is inserted at the right side and the current is automatically turned on or off by the action of putting in and removing the curling iron. Hooks are provided for hanging the curling iron when out of use. The device is polished nickel finish, mounted on enamel slate and arranged to fasten to standard outlet box or on wall as ordered. This product is the result of the cooperation of an expert theatre electrician, George A. McCurdy, of New York, and the company's engineers, and has been installed in several new theatres.



ELECTRIC HEATER APPARATUS.

The combination curling iron and grease-paint heater No. 1280 is in extended use, and the two types are calculated to meet all requirements.

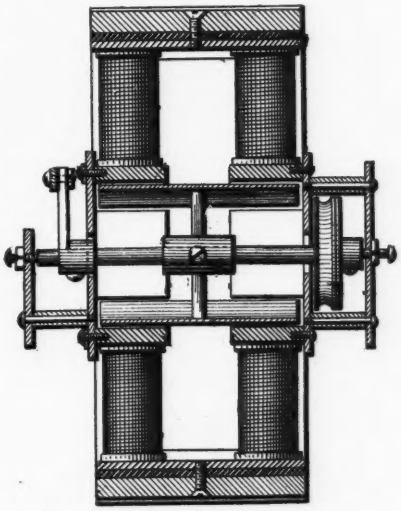
Wireless Telegraphy.

It is reported by the British technical press that Marconi has succeeded in establishing a wireless telegraph service between England and Holland. Messages are transmitted from Poldhu to Amsterdam, a distance of 200 miles, of which forty miles are overland in the south of England. It is said that a commercial daily paper in Amsterdam has arranged to receive its news in this way.

One cubic inch of steam will expand 1,728 times, or to about one cubic foot. It is this property of steam that makes it valuable as a creator of motive power. The explosion of gas in engines acts in the same manner. Upon the explosion taking place the material expands to many times its original volume, and, in the same manner as steam, drives the piston from one end of a cylinder to the other.

A New Type of Electric Motor.

Mr. David Patton Burdon has assigned a two-thirds interest to Samuel P. Holmes and Gustave Muller, all of Jacksonville, Fla., in a patent recently obtained by him on an electric motor. A tubular frame is employed comprising angularly disposed wall sections, having their abutted edges detachably secured together by connecting-plates and reenforcing-strips. Within this frame are mounted inwardly extending independent sets of field-magnets, each magnet consisting of a pair of electromagnets, having cores secured at their outer ends to transverse metallic bars, which are in turn fastened to the frame, insulation-sheets being interposed between the frame and bars. The inner ends of the cores are provided with curved pole-pieces, the ends of which are spaced apart, the pole-pieces thereby forming sectional rings within the frame. Fastened to the outer sides of the pole-pieces are journal brackets comprising face-plates, secured by screws to the pole-pieces, posts, fastened to the face-plate, and journal-plates, secured to the outer ends of the posts. A rock-shaft extends concentrically between the pole-pieces and is supported by journal-screws engaging the ends of these; the screws pass through the plates and are normally locked against movement by jam-nuts. The field-magnets are disposed radially with respect to this rock-shaft. Armature-magnets of soft iron are carried by the rock-shaft, being located in the space between the pole-pieces. These magnets are connected with a hub by means of arms, the hub being fastened by a suitable screw to the rock-shaft. The armature magnets are located on opposite sides of the shaft, and therefore simultaneously coact with the opposed field-magnets of each set, while alternately coacting with the sets. Suitably secured to one end of a rock-shaft is a pulley that is located between the face-plate and the journal-plate, but outside the frame of the motor. This pulley constitutes the driving element from which power may be imparted to the machine or article to be driven. The opposite end of the rock-shaft carries a crank-arm, located outside of the frame and to which the switch mechanism is connected. This mechanism is as follows: upon one side of the frame are located upstanding journal-posts, formed by the upturned terminals of a metallic strip secured upon a transverse metallic sheet. Binding-posts are attached to the opposite ends of the sheet. In the upstanding posts is journaled a rotary shaft, disposed transversely of the frame and projecting beyond it. One end of this shaft carries a flywheel to which is fastened one end of a pitman, the other end of the pitman being connected to the crank-arm of the rock-shaft. To the other projecting end of the rotary shaft is secured a rotary drum which constitutes one element of a switch, said drum having a contact-strip on its periphery, which extends partially about the same. It is electrically connected with the shaft by means of a metallic plate secured to the drum and engaging the shaft and a lug carried by the strip and attached to the plate. As a result, the contact-strip is in electrical connection with the binding-posts through the shaft, the posts, the strip and plate. Coacting with the rotary drum are metallic brushes, bearing against its opposite sides and secured to an insulator-disc, fastened to one side of the frame, these brushes being provided with binding-posts, to each of which one pole of a



HORIZONTAL CROSS-SECTION OF ELECTRIC MOTOR.

battery is attached, the other poles of the batteries being attached to binding-posts, secured to the frame on opposite sides of the switch. The upper and lower sets of the field-magnets are electrically connected, as are also the horizontal sets. The motor is preferably operated by two separate batteries, one of which has its poles connected with one of the binding-posts, the other battery being connected with the other corresponding posts. When the armature is in position the rotary member of the switch will be so located that the contact-strip will be in engagement with the brush that is electrically connected with the first battery. Consequently the circuit of the battery will be closed and the current passing through the various electrical connections will energize the field-magnets, while the other circuit being broken, the horizontal magnets will be deenergized. The magnets will therefore attract the armature magnets, causing an oscillation of the rock-shaft. This movement will rotate the shaft, carrying the rotary member of the switch around, so that the contact-strip will be moved into engagement with the other brush while disengaging from the first-mentioned brush. As a consequence the vertical magnets will be deenergized, while the horizontal magnets will be energized. A reverse movement of the armature therefore takes place, this movement causing a continued rotation of the upper shaft. Thus the armature is oscillated and a similar movement may be imparted through the medium of the pulley to any machine or article driven. While the use of two separate sources of electrical energy is preferable, the invention is not limited in this respect.

Electric Lighting in Photographic Laboratory.

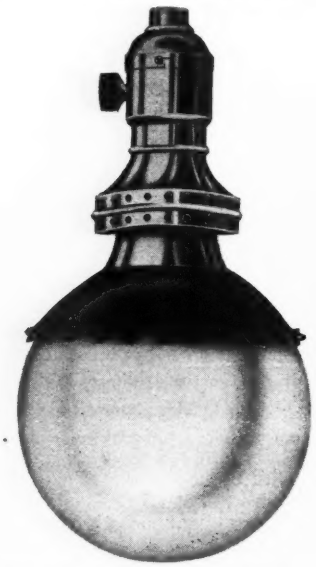
In one sense it is unfortunate that those rays of light to which the eye is most sensitive are not those which have the greatest actinic value, so that a photograph taken under ordinary conditions never has the same value of lights and shades as the object when seen. On the other hand, were it not possible to see with a light which has little or no actinic value, practical photography would be exceedingly difficult. In this article M. P. Simon discusses the question of the proper use of lights in photography, and methods of controlling not only the intensity of the illumination, but its quality. This is impossible either with daylight or any form of light employing a flame, because the quality of light obtained in this way does not change with a change in intensity. This is not true of the incandescent lamp, the intensity of which is not only easily varied by varying the applied voltage, but with this change in intensity the actinic value is changed. Thus, cutting down the candle-power of an incandescent lamp to one-half lowers the actinic value more than one-half. This property enables the photographer to control both the intensity of light in his laboratory and its actinic value, as he may lower the luminous intensity of one lamp to one-tenth the original amount, and by adding nine other lamps regain the original illumination so far as the eye is concerned, and yet have a light that is very weakly actinic. The author uses this method in his laboratory, and has obtained very good results, as he is not forced to work with faint illuminations.—*L'Electricien (Paris), March 5.*

The Monarch Incandescent Lamp.

The accompanying illustrations show two types of the Monarch incandescent lamp, which is made by the Monarch Electric Manufacturing Company, of Warren, Ohio. The Monarch lamp is adapted

TWENTY-FIVE-CANDLE-POWER "MONARCH" LAMP.

for use in any standard socket, and it is made in two sizes, for use on both direct and alternating-current circuits. The No. 1 lamp is a round bulb five inches in diameter, and the No. 2 lamp is a round bulb three and three-quarters inches in diameter. The bulbs are sand-blasted, giving them a frosted appearance, and are made for either Edison or T.-H.



FIFTY-FIVE-CANDLE-POWER "MONARCH" LAMP.

sockets. The voltages have a range from 90 to 125 and from 200 to 250.

The No. 2 lamp is a twenty-five-candle-power lamp, and the only fixture that is necessary for use on any standard socket is a polished aluminum reflector finished in dead black on the outside.

The No. 1 lamp is a fifty-five-candle-power lamp, and is about the same as No. 2, except, for the purpose of ornamentation a brass or oxidized copper collar, fitted with a spring which holds the reflector firmly in place, is used.

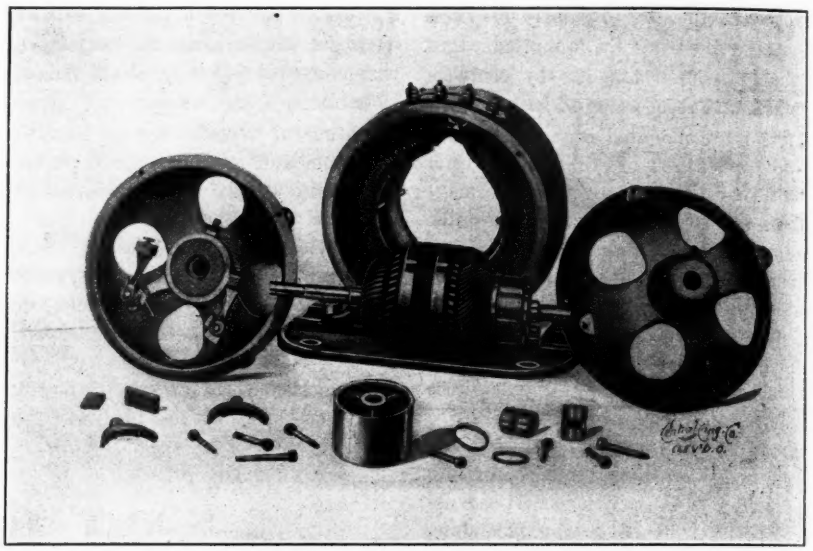


FIG. 1.—ASSEMBLY OF "IDEAL" BIPOLAR MOTOR.

Trouble has been experienced with lamps of this type, in that with the large lamp the spring in the collapsible collar became injured due to the intense heat, which took out the temper. In order to reduce this trouble to a minimum, the maker of the Monarch lamp introduced a collar, shown in the illustration, which has a number of perforations entering into the spring chamber. This permits

"IDEAL" SEMI-ENCLOSED BIPOLAR MOTOR.

the circulation of air, keeping down the temperature of the spring.

The Monarch Electric Manufacturing Company was incorporated on November 16, 1903, for the purpose of manufacturing incandescent lamp specialties. Mr. H. B. Ramey is the manager of the company. The company is carrying a large stock of these lamps on hand, and can make prompt shipments in any quantities.

The Ideal Bipolar Steel-Frame Motors.

The Ideal Electric and Manufacturing Company, Mansfield, Ohio, in designing the line of motors shown in the accompanying illustrations, had in view an apparatus of small sizes that would meet the demand for a universal machine adapted to all lines of service. These machines may be run in any position—on the floor, wall or ceiling, for belted or direct-connection, with a range of speeds and corresponding ratings suitable to almost every condition.

The field frame is of the best grade of soft dynamo steel, cast solid. The heads or bearing brackets are made of cast iron, drilled on templets and securely bolted to the field frame. Large and easily accessible oil reservoirs are provided, which are fitted with drain cocks. This line of motors is also listed with solid heads or bracket bearings, making them entirely enclosed. Fig. 1 shows the Ideal motor in its various details of construction.

The shafts are made from high-grade machine steel, well proportioned for the respective sizes. The machines are provided with cast-iron subbases, to which the frames are bolted. The belt tension is obtained by adjusting the screws which are furnished with belted machines.

The armature cores are made up from sheet steel, the core discs being mounted directly upon the shaft and keyed. The discs are punched and notched by the use of a solid single die, ensuring accuracy in slot formation. Suitable ventilation is provided throughout the armatures, ensuring cool running. The windings consist of machine form-wound coils

in the large sizes, and special hand-wound coils in the small sizes.

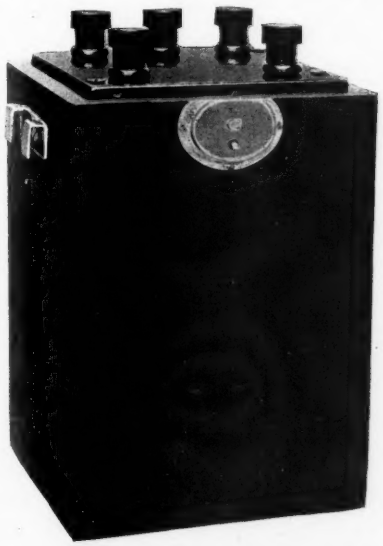
The commutators are built up of uniform segments of pure lake copper, insulated with special mica throughout. On the smaller sizes the commutators are secured in place by shrinking on to the shaft a taper sleeve, which really forms part of the commutator flange, the taper being turned for a driving fit. On the larger sizes the shaft and sleeve are provided with a key-way with a substantial key inserted, the commutator resting against a shoulder on the shaft.

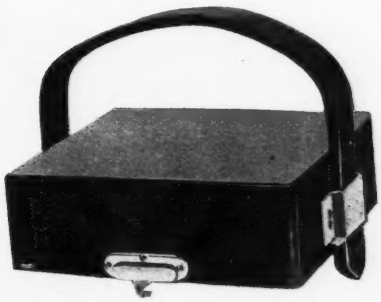
The brush-holders are of a new design, made of brass and heavily constructed. Each brush is provided with individual adjustment for varying the tension of the brushes on the commutator. The brushes are of copper-coated carbon, and are of easy access for cleaning or renewing.

The field coils are form-wound and thoroughly insulated. Each coil is coated with insulating varnish, carefully baked and then taped with insulating tape. The coils are then given another coat of varnish and thoroughly baked and tested before being placed on the machine.

These machines were designed for their rated load under continuous service and at low heating limits. The semi-enclosed machines will run continuously under full rated loads, without a rise in temperature to exceed thirty-five degrees centigrade above the surrounding air, and will withstand overloads of fifty per cent for a period of one hour, or 100 per cent momentarily.

SERIES TRANSFORMER FOR PRIMARIES UP TO 100 AMPERES.

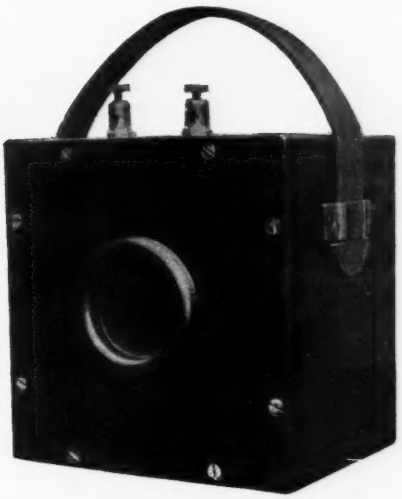




VOLTAGE TRANSFORMER FOR CAPACITIES UP TO 750 VOLTS PRIMARY.

Portable Voltage and Series Transformers.

In taking electrical measurements too much care can not be exercised in the avoidance of errors. It frequently happens that the best instruments for the work in hand are not available, and the readings to be taken are such that they are out of the range of the instruments at hand. In order to simplify the use of standard instruments, the Westinghouse Electric and Manufacturing Company has designed a line of portable voltage and series transformers. These are illustrated in the accompanying figures. The transformers are particularly designed to adapt the voltage or current to be measured to the capacity of the instrument to be used, adopting a ratio which will permit readings to be taken from the most legible portions of the scale.



SERIES TRANSFORMER FOR LARGE CAPACITIES.

These series and voltage transformers are carefully made, ample insulation and a generous amount of iron and copper being used to reduce to a minimum the error of transformation. They are designed to give accurate ratios at the load which will normally be imposed on the secondary by the ordinary type of portable instrument, the output of the voltage transformer being about 0.15 ampere, and the maximum voltage across the secondary of the series transformer being about three volts.

The series transformer is made in two types. In one, designed for primary coils up to 100 amperes, the ratio is changed by plugs, somewhat as in the Wheatstone bridge. In the other, which is designed for larger capacities, there is a circular opening through the transformer, and a conductor is passed through this opening, forming the primary. In this type the ratio is changed by the number of turns

made by the conductor, passing it through the aperture once giving a ratio of 400 to 5; twice, a ratio of 200 to 5, and five times, a ratio of 100 to 5.

The voltage transformers are furnished in various capacities up to 750 volts primary, the standard secondary voltage at the maximum primary voltage being 150 volts. The terminals on the primary are arranged so that a number of primary voltages may be obtained, although they are not usually required in a great range of capacities, as is the case with the series transformer.

These transformers are mounted in finely finished mahogany cases with carrying handles. The terminals of the voltage transformers and the plug contacts of the series transformers are protected by a cover which, for convenience in use, is made removable.

Prosperity in the West.

Mr. George J. Gould returned on Monday, March 14, from an extended trip of inspection of his transcontinental railroad system. The following statement appeared in the New York *Herald* on Thursday, March 17, detailing his views on general conditions in the West:

". . . With the exception of Colorado and Utah, where labor trouble has temporarily impeded the onward march of industry," he continued, "we found a very high degree of prosperity. This was especially true of the Southwestern cities and California. The banks are on a solid basis. The business men and the farmers have more money than they ever had before, and this means prosperity, industrial advancement and the distribution of vast natural resources. High prices for cotton have made the state of Texas opulent beyond expectation, and there is a good prospect for a big crop next season.

"New Orleans and Galveston have profited by the great volume of trade that has passed through these ports during the last year, and at Galveston the citizens are building a great wall seventeen feet high, seventy feet across and three and a half miles long to protect them from the ocean. Two miles have already been built. I mention this to illustrate the remarkable recuperative power of the western cities. Galveston, devastated a few years ago, has risen from its desolation and is willing to fight with greater vigor than before for its existence.

"The doubt and pessimism which have dominated the East for a year are not found west of the Mississippi nor south of St. Louis. The setback in Colorado is only for the present. As soon as the labor troubles are settled that state will join the others which are now sharing the bulk of the prosperity.

"We were very well satisfied with the improvements that are being made at great expense by the Iron Mountain, the Texas Pacific and the allied lines of the Missouri Pacific system. All these expenditures will be justified. The White River Railway will open new territory and new construction in connection with the low-grade Mississippi line and virgin forests in Arkansas will be brought within the reach of commerce.

"The reconstruction of the Little Rock & Fort Smith, which has cost $3,000,000, will enable more economical operation and will form a valuable connection between western Kansas and New Orleans.

"Traffic throughout the entire Southwest has shown no decrease, and the physical condition of all the railroads over which we passed is far better than it has ever been before. This means a saving in the cost of operation.

"So far as we were able to judge, the condition of winter wheat is satisfactory, with the exception of southwestern Kansas, where there has been a lack of moisture. Since we passed through that state, however, I believe there has been rain."

Referring to the Southern Pacific, on which there has been spent in improvements during the last three years between $60,000,000 and $70,000,000, Mr. Gould said: "The result of these expenditures is very evident. The property is in splendid condition and the traffic originating along the system is enormous. On our return we passed over the Lucin cutoff, which is a grand piece of work."

The Marine Review.

The current issue of the *Marine Review,* published at Cleveland, Ohio, is designated as its fitting-out number. In addition to this there is considerable space devoted to a discussion of the shipping question in all its various phases. The list of contributors upon this subject includes the Hon. George B. Cortelyou, secretary of the department of commerce and labor; Senator William P. Frye; John McNeil, president of the Brotherhood of Boiler-Makers and Iron Shipbuilders of America; Mr. Winthrop L. Marvin, author of "The History of the American Merchant Marine;" the Hon. T. E. Burton, chairman of the committee on rivers and harbors of the house of representatives; Colonel Thomas W. Symons, member of the Erie canal advisory commission; Mr. Harvey D. Goulder and Mr. W. L. Brown.

American Institute of Electrical Engineers.

ASSOCIATES ELECTED AT DIRECTORS' MEETING, NEW YORK, FRIDAY, FEBRUARY 26, 1904.

Ulysses Sage Atkins, Asotin, Wash.
E. F. W. Alexanderson, Schenectady, N. Y.
Elbert Grover Allen, Seattle, Wash.
Harry R. Allensworth, Columbus, Ohio.
John Bernhard Armack, Columbus, Ohio.
Fred. W. C. Bailey, Columbus, Ohio.
Pierre J. Boucher, Cleveland, Ohio.
Valentine Boyd, East Toronto, Ontario.
Victor Brunskog, Columbus, Ohio.
John Myron Bryant, Urbana, Ill.
W. W. S. Butler, Durham, N. C.
John Campbell, Chelsea, Mass.
Burdette Leonard Chase, Columbus, Ohio.
Thomas E. Clark, Detroit, Mich.
Stuart Mortimer Conant, Atlanta, Ga.
Harry Lawrence Cook, Columbus, Ohio.
John William Cooke, Boston, Mass.
Bradford Darrach, Jr., Boston, Mass.
Charles Staples Davis, Somerville, Mass.
Rudolph J. Decker, Salt Lake City, Utah.
F. A. Demarest, Trenton, N. J.
Theodore B. Entz, Baltimore, Md.
Lawrence Ettrup, Sacramento, Cal.
Frank Gaiennie, Jr., St. Louis, Mo.
Edgar W. Gough, Great Barrington, Mass.
Leo Gudeman, Columbus, Ohio.
Ernest H. Haughton, Cincinnati, Ohio.
William A. Hopkins, Jr., Columbus, Ohio.
Hubert F. Krantz, Brooklyn, N. Y.
John Ingram Leitch, Evanston, Ill.
Emile G. Lind, Melbourne, Australia.
Max J. Levy, New York city, N. Y.
Albion Dana Topliff Libby, Austin, Ill.
William Kelsey Liggett, Columbus, Ohio.
Charles Mautner, New York city, N. Y.
Kenneth McCaskill, Schenectady, N. Y.
William McClellan, Philadelphia, Pa.
John McFeeley, Camden, N. J.
Edward H. Monasmith, Columbus, Ohio.
John H. Moore, Columbus, Ohio.
Frederick J. Parkin, Toronto, Ontario.
Albert Edwin Peirce, Jr., Steelton, Pa.
Milton Adolphus Pixley, Columbus, Ohio.
Edmund Hugh Pryce, Rutherford, N. J.
John Royall Read, Whitmore, Cal.
Harry Palmer Reid, Pittsfield, Mass.
Sidney Leonard Rich, Atlanta, Ga.
L. A. Sackett, Columbus, Ohio.
Frank C. Sargent, Malden, Mass.
Samuel Scott, Columbus, Ohio.
John Augustine Seede, Schenectady, N. Y.
Samuel Holmes Smith, Pittsfield, Mass.
James Otis Spear, Jr., Philadelphia, Pa.
Harold Brooke Stabler, Washington, D. C.
Harford Toland Stewart, Columbus, Ohio.
George Hoxie Stickney, Lynn, Mass.
Richard Stites, Columbus, Ohio.
John Francis Tinsley, San Francisco, Cal.
Harris Cushman Trow, Chicago, Ill.
William A. Turbayne, Lancaster, N. Y.
Charles W. Underwood, Buffalo, N. Y.
Albert C. Vinal, New York city, N. Y.
George W. Watts, Toronto, Canada.
Carl J. E. Waxborn, Columbus, Ohio.
Elmer Bert Wharton, Columbus, Ohio.
Arthur Howard Woodwell, Spokane, Wash.
Richard Hermon Zavitz, Montreal, Canada.

TRANSFERRED FROM ASSOCIATE TO MEMBER.

Harry Alex. Mavor, Glasgow, Scotland.
Fred. Brainard Corey, Schenectady, N. Y.
Albert H. Armstrong, Schenectady, N. Y.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

POWER PLANT FOR SHOSHONE FALLS, IDA.—An electric power enterprise is about to be launched in Idaho, and articles of incorporation are being drawn up for the Shoshone Falls Power and Lighting Company. The new corporation is capitalized at $2,500,000. It is the purpose to build three power plants on the Snake river, which will have a total of some 100,000 horse-power. The plants will be located at Augur Falls, Twin Falls and Shoshone Falls, respectively.

POWER COMPANIES CONSOLIDATE—The Snoqualmie Falls & White River Power Company, organized with a capital of $3,000,000, has taken over the property, franchises and business of the Snoqualmie Falls Power Company, White River Power Company, Seattle Cataract Company and Tacoma Cataract Company. At the annual meeting of the stockholders the following officers were elected: Charles H. Baker, president and chief engineer; E. C. Neufelder and O. D. Colvin, vice-presidents; Thomas B. Hardin, general counsel and secretary; Lester Turner, treasurer; James C. Drake, district manager; George Browne, Fred. Bausman and S. G. Simpson.

A NEW VERMONT POWER COMPANY—The Hoosac Mountain Electric Power Company has begun excavations for the foundation of the dam at Howes pond, at Readsboro, Vt. When the dam is completed it will raise the water of the pond fourteen feet above its present level and flow over a large tract of land. The water will be taken from this reservoir to a point on the Deerfield river about three-quarters of a mile below the village of Readsboro, where a power-house will be erected. The fall of water at this point will be 1,200 feet. The rights for a dam and reservoir on the Deerfield river, at the point where the power-house is to be erected, have also been purchased by the Hoosac Mountain Electric Power Company, and will be used in connection with the Howes pond power.

A LONG-DISTANCE RAILROAD FOR THE SOUTHERN STATES—An electric line from Richmond to Portsmouth, Va., covering a distance of 300 miles, has been chartered at Richmond, Va. The principal incorporators are Norfolk capitalists, and the capital stock is placed at from $250,000 to $800,000. Work is to be started at once, and power-houses built along the route. The principal offices of the company are to be located at Suffolk. The officers named in the charter are Luther R. Britt, president; W. H. Robinson, Norfolk, first vice-president; George L. Barton, Suffolk, second vice-president; W. D. Southall, treasurer; George H. Lewis, general manager, and Lee Britt, of Suffolk, secretary and auditor. The route will be from Richmond to Petersburg to Portsmouth, through the counties of Dinwiddie, Prince George, Sussex, Surrey, Southampton, Isle of Wight, Nansemond and Norfolk.

FOR A THROUGH TROLLEY LINE FROM NEW YORK TO PHILADELPHIA—The Public Service Corporation of New Jersey has purchased the Middlesex & Somerset Traction Company, which has fifty miles of track in Middlesex and Somerset counties, for $2,250,000. The buying of the local trolley system completes the Public Service line from New York to Philadelphia. The company recently added to its through line by purchasing the line from Camden to Trenton, and it is now building a road from the terminus of the Camden road at Trenton to connect with the end of the Trenton fast line at the fair grounds. The Public Service Corporation has already mapped out plans for the improvement of the local system. It is understood that $1,000,000 has been set aside for the improvement of the system in Somerset and Middlesex counties, and also of the lines of the Raritan Traction Company, which were purchased a few weeks ago. The price paid for the Raritan Traction Company property was $500,000.

AUXILIARY WATER POWER SYSTEM FOR NEW YORK CITY —Mr. N. S. Hill, Jr., chief engineer of the department of water supply, gas and electricity, New York city, has presented a report to Commissioner John T. Oakley, detailing plans for installing mains, pumping stations and hydrants for a high-pressure water service for fighting fires. It is planned to install the system in Manhattan borough in the district bounded by Twenty-third street on the north, Broadway to Fourteenth street, to Fourth avenue, to the Bowery, to Chambers street on the south, and to the North river on the west, including some 1,350 acres. The plans provide for three pumping stations, with a capacity of 1,000,000 gallons an hour, each giving a pressure of 200 pounds to each hydrant, of which there will be 210 for salt-water. It is estimated that the cost of the proposed plant in Manhattan, with electric motors, will be $3,950,400, and for a gas engine equipment, $5,293,200. The plans submitted provide for both fresh and salt-water connections at the pumping stations. The fresh water is drawn from the Croton system. This system is capable of supplying any or all of the stations. In the event, however, of any shortage of supply of fresh water, the salt-water may be immediately used without interference to the operation of the plant. The use of fresh water, with salt-water available when needed, removes one of the chief objections offered to the proposed service, which was that the salt-water possessed many deleterious effects, both with regard to the corrosion of the mains and the spoilage of salvage at a fire. Accompanying the report was a map showing the boundaries of the district, together with a preliminary plan of the trunk line and distributing system of high-pressure mains, and detailed plans of the proposed pumping stations.

TELEPHONE AND TELEGRAPH.

FARGO, N. D.—Contracts have been signed for an independent telephone exchange at Halstad.

SPRINGFIELD, MASS.—A telephone system is to be established in the towns of Wyben and Montgomery.

FAIRMOUNT, IND.—Another trunk line will be built from this city to Marion by the Citizens' Telephone Company.

HAZLETON, IND.—An independent telephone company has been formed here. C. S. Stevens is president and manager.

ASHLAND CITY, TENN.—The Cumberland Telephone Company is making arrangements to put in an exchange here.

CUSSETA, GA.—The Southern Bell Telephone Company has been granted permission to use the streets of the town.

CINCINNATI, OHIO—The Norwood Citizens' Telephone Company has been granted a twenty-five-year franchise to operate in Norwood.

GRANTSBURG, WIS.—A telephone company has been organized at Swiss by the farmers of Burnett County, to run from Gordon, on the Omaha, to Grantsburg.

BALTIMORE, MD.—The Riverton Telephone Company has been organized at Sharptown, and will erect a telephone line from Mardella Springs, *via* Riverton, to Sharptown.

BURLINGTON, VT.—The New England Telephone and Telegraph Company has purchased the independent telephone line that has been operated in North Bennington for several years.

CLARKSVILLE, VA.—At a special meeting of the town council a franchise was granted to the Southern Bell Telephone Company to erect its poles and wires in Berryville and locate its system here.

HELENA, MONT.—The Bell Telephone Company is preparing to put in a complete metallic circuit between Basin City and Sheridan and Buffalo, Wyo., which will greatly improve the service between Billings and those points.

CAMDEN, OHIO—A new telephone company has been organized here, to be known as the Camden & West Elkton Telephone Company. The interested parties are William Davis, I. Talbert and A. Kreckler, of West Elkton, and H. H. Payne and W. G. Hall, of Camden.

SALT LAKE CITY, UTAH—The Independent Telephone Company states that by May 1 it will have expended $1,000,000, and will have connection with Ogden and Salt Lake. In six months there-

after the company purposes to have its system established in Pocatello, and in one year to connect with Butte and Helena.

MARION, IND.—The town council of Roann has granted a franchise to the Disko & Laketon Telephone Company to maintain an exchange in that town. This company is composed of Laketon, Disko and Roann people, who are uniting for a system of telephones over all that section of the country. An exchange will be put in as soon as possible.

DENVER, COL.—The Wray Telephone Company has decided to enter Colorado, and arrangements have already been made whereby residents of Akron, Yuma, Brush, Wray, Fort Morgan and other towns in eastern Colorado will, within sixty days, be able to have telephonic communication with Denver; Atwood, Kan.; St. Joseph, Mo., and Kansas City.

WINONA, MINN.—The Tri-State Telephone and Telegraph Company has its poles all placed between Hastings and Wabasha for the long-distance line it is going to build to Winona this year. The route between Wabasha and Winona has not been fully settled. The river road may be followed or the line may run inland to take in Rollingstone and Oak Ridge.

LEWISTON, IDA.—The telephone lines of the Lookout Telephone Company, a system comprising eighty miles and connecting Lewiston, Lapwai, Culdesac, Melrose, Ilo, Lookout, Gifford and Peck, have been purchased by the Interstate Cooperative Telephone Company, which states that the system will be extended from Moscow to Genessee, Lewiston, Kendrick, Juliaetta and Leland.

KANSAS CITY, MO.—The directors of the Western Independent Telephone Company have decided to begin building a line from Kansas City to Excelsior Springs at once. It will connect with the Excelsior Springs independent telephone system. From Excelsior Springs a line will be built to connect with Carrollton and other towns along the river. It has also been decided to build a line from Independence to Higginsville, and another from Olathe to Ottawa, Kan., to complete the Kansas City-Ottawa line.

HOUSTON, TEX.—At a meeting of the stockholders of the Orange Telephone Company, the following board of directors was chosen for the ensuing year: E. R. Webber and Dr. I. E. Graham, of Marseilles, Ohio; W. H. Bitzer, Forest, Ohio; John Pfeiffer and Jacob E. Lintz, Kenton, Ohio; W. D. Bettis, J. W. Link and F. D. Pfeiffer, of Orange, Tex. The stockholders recommended the following officers for election: president, John Pfeiffer, Kenton, Ohio; vice-president, W. D. Bettis, Orange, Tex.; secretary-treasurer, E. R. Webber, Marseilles, Ohio.

HAMILTON, OHIO—A new telephone company has been organized in Camden, to be known as the Camden & West Elkton Telephone Company, which will work in connection with the Bell Telephone Company. Those locally interested in this enterprise are William Davis, I. Talbert and Al. Kreckler, of West Elkton; H. H. Payne and W. G. Hall, of Camden. William Davis has been elected president; W. S. Hall, secretary and manager, and W. S. May, treasurer. The company will build a new metallic line to West Elkton at once.

BOSTON, MASS.—At the annual meeting of the Rocky Mountain Bell Telephone Company, controlled by the American Telephone and Telegraph Company, B. F. White, of Montana, was elected a director to succeed C. U. Clark. The annual report shows these financial operations for the year ended December 31, 1903: revenue, $863,144; expenses, taxes, etc., $648,101, leaving net earnings of $215,054; paid in dividends, $134,863, leaving a surplus of $80,179, as compared with a surplus of $72,710 for 1902. The company now has 19,000 subscribers.

ROCKFORD, ILL.—The Winnebago County Telephone Company at its annual meeting elected the following board of directors: D. W. Barningham, H. S. Hicks, Charles F. Tritle, A. J. Lovejoy, A. J. Barningham, of Durand; B. E. Collins, of Rockton; W. F. Attley, of Durand. It was decided to put all earnings into additional construction. The company has about 150 miles of line in operation and expects to increase same by an additional hundred before the year is out. The officers chosen by the directors were B. E. Collins, president; C. F. Tritle, vice-president; H. S. Hicks, secretary, and Chan Starr, treasurer.

PERSONAL MENTION.

MR. WILLIAM PATTON has been appointed to manage the long-distance lines of the Western Independent Telephone Company, Kansas City, Mo.

MR. RAY D. LILLIBRIDGE, the well-known technical advertising expert, has returned from a two-months' trip to the West, visiting particularly Colorado and the Pacific coast.

MR. EDWARD WESTON, of Newark, N. J., has had conferred on him the degree of LL. D., by McGill University, in recognition of his investigations and inventions in electrical science.

MR. LEROY W. STANTON, consulting telephone engineer, has opened an office in Chicago, Ill., in connection with Mr. Bryan B. Carter, mechanical engineer, in the Monadnock Building.

MR. G. E. BENNETT, who was formerly assistant manager of the Chicago office of the Nernst Lamp Company, has been made district sales manager of the company, with offices at Buffalo, N. Y.

MR. CLARENCE A. ROSS, who has been for several years manager of the Chicago office of the Sawyer-Man Electric Company, was recently appointed general western agent of the company.

MR. J. I. VERNON, acting signal engineer of the New York, New Haven & Hartford Railroad Company, has moved his offices from Bridgeport, Ct., to the South terminal station, Boston, Mass.

MR. HARVEY D. PATTERSON, formerly superintendent for Mr. Max Osterberg, has become connected with the United States Battery Company, New Rochelle, N. Y., in the capacity of electrical engineer.

MR. HERBERT LAWS WEBB, the well-known telephone engineer, has returned to England, where he has established a consulting engineering office at 35 Old Queen street, Westminster, S. W., London, England.

MR. C. E. WILD, who has been division superintendent for some time past for the Michigan Telephone Company, Menominee, Mich., has been transferred to Grand Rapids, Mich., to assume a district superintendency there.

MR. E. P. SHAW, Jr., who is well known in New England street railway circles, and a member of the Shaw syndicate, has been appointed superintendent of the Boston & Worcester street railway system. Mr. Shaw succeeds Mr. A. C. Ralph, resigned.

MR. HERBERT S. MALLALIEU, recently connected with the publishing department of the Westinghouse Electric and Manufacturing Company at its New York office, has been appointed assistant to the assistant manager of the British Westinghouse Company.

MR. OSCAR T. CROSBY, the distinguished engineer and explorer, delivered a lecture before the New York Electrical Society, at 19 West Forty-fourth street, on Wednesday evening, March 23. The lecture was illustrated by a number of lantern slides.

MR. F. N. HIBBITS has been appointed consulting mechanical engineer of the Southern Railway Company, with headquarters at Washington, D. C. Mr. Hibbits was formerly superintendent of motive power and machinery of the Union Pacific Railroad Company.

MR. J. RICE, of the Standard Electrical Manufacturing Company, Niles, Ohio, has opened an eastern office at 19 Park place, New York city. Mr. Rice will be sales manager, and will manage the company's sales for eastern New York, eastern New Jersey and part of New England.

MR. GEORGE W. FOWLER, who for several years past has been connected with the engineering department of the C. & C. Electric Company, has resigned from the company to accept a position with Mr. George D. Beinert, the well-known electrical contractor of New York city, N. Y.

MR. J. W. HARPER has been placed in charge of the traffic department of the Georgia Telephone and Telegraph Company. Mr. Harper has been connected with the collection department of the company since the business was started, and his services in this department led to his promotion to his present position.

MR. ARVID REUTERDAHL is the author of two interesting studies entitled, respectively, "The Radioactive Atom" and "Electrolysis According to the Energonic Hypothesis." These have been reprinted in pamphlet form and are being distributed, with the com-

pliments of the author, to interested parties in the electrochemical and electrical fields.

MR. MATTHEW C. BRUSH, Boston, Mass., has been appointed general manager of the Boston and Suburban electric companies. Mr. Brush was formerly of Minnesota, and came to Boston from western Kansas last July to accept the position of assistant to President Claflin. The Boston and Suburban electric companies include six lines in Boston and vicinity.

MR. HIRAM PERCY MAXIM lectured on Tuesday evening, March 22, before the Automobile Club of America, on "Commercial Vehicles." The subject was taken up with special reference to the cost of maintenance, under actual service conditions, of electric wagons and trucks equipped with the batteries, tires and general equipment used as standard at the present time.

MR. H. B. RAMEY, manager of the Monarch Electric Manufacturing Company, Warren, Ohio, is expected to visit New York city shortly. Mr. Ramey was formerly connected with the sales department of the Warren Electric and Specialty Company and also with the Peerless Electric Company, Warren, Ohio. He resigned his position with the Peerless company on December 1, 1903, to assume the management of the Monarch company.

MR. JAMES I. AYER, chairman of the committee on relations with kindred organizations of the National Electric Light Association, announces that arrangements have been made by which the association will have a permanent headquarters at the St. Louis World's Fair. This headquarters will consist of a railed enclosure furnished with chairs, a convenient desk, etc., for the use of its members. The location will be in a section used also for an Edison historical exhibition, the headquarters of the Association of Edison Illuminating Companies and the headquarters of the American Institute of Electrical Engineers. A register will be provided, and it is desired that all members visiting the headquarters will register their name, local address and probable duration of visit. It is believed that this register will be of much value to visiting members, and that it will also serve as an indication of the usefulness of a headquarters at this important exposition.

MR. PHILETUS W. GATES AND MR. HENRY W. HOYT, respectively general superintendent and second vice-president of the Allis-Chalmers Company, are about to retire from active participation in the management of that company. Mr. Gates was president and Mr. Hoyt secretary and general manager of Gates Iron Works for fifteen years prior to the incorporation of the Allis-Chalmers Company in 1901. They have been prominently connected with the manufacturing interests of Chicago and have taken an active part in all of the manufacturers' associations. The late P. W. Gates (father of Philetus W. Gates) was the pioneer manufacturer of Chicago and the region west of the Alleghenies, having established his business in 1842. From 1861 to 1871 the Eagle Works Manufacturing Company, of which he was president, employed about one thousand men, and in those days was a noteworthy industry. In 1871 the Eagle Works Manufacturing Company went out of existence, and from it were organized Gates Iron Works and Fraser & Chalmers, each taking a portion of the business. Both of these companies in turn were taken oyer by Allis-Chalmers Company in 1901. Messrs. Hoyt and Gates, after a well-earned vacation spent in traveling, will reengage in business in Chicago.

MR. C. O. BAKER, JR., for many years the popular and efficient master of transportation for the National Electric Light Association, has resigned from that position. Mr. Baker expects to be in Europe at the time of the Boston meeting, to be held May 24-27 next, and feels that he should not continue in the office unless he can personally attend to the duties connected with it. President Edgar has appointed Mr. George F. Porter to succeed Mr. Baker. Mr. Porter had charge of transportation matters before he became secretary of the association, and organized special trains for the Detroit convention, February, 1887, the Chicago convention, February, 1889, and the Kansas City meeting, February, 1890. The resignation of Mr. Baker will be a matter of great regret to electric light interests throughout the country. Under his able management the matters of transportation in connection with these conventions have been carried out to the entire satisfaction of the delegates from all parts of the country and he has been very successful in working up attendance. It is not only with the members of the National Electric Light Association, however, that Mr. Baker has been popular, for his tact and complete knowledge of traffic affairs won for him the confidence and good will of the railway people.

ELECTRICAL SECURITIES.

The market for some time past has been characterized by slow movements and considerable apathy. Notwithstanding severe breaks in foreign markets and more or less excitement in produce exchanges, the stock market in general has been more quiescent than in many years. The past week, however, has proved a decided change from this condition. The decision in the Northern Securities case is probably one of the most important financial verdicts which has ever been rendered, and although it was against the holding company, this was expected, and proved to be even less of a shock than the most sanguine had hoped for. It is a matter of considerable satisfaction to large financial interests that, despite the adverse merger decision, prices are better, even on the stock which has been under litigation. The assignment of D. J. Sully, who has controlled the cotton situation for some time, while it caused a bad break for one day, has not materially affected cotton prices, and these are now back almost to the high level which they reached due to his manipulation.

ELECTRICAL SECURITIES FOR THE WEEK ENDING MARCH 19.

New York:	*Closing.*
Brooklyn Rapid Transit	43¾
Consolidated Gas	194¼
General Electric	166¼
Kings County Electric	183
Manhattan Elevated	143⅜
Metropolitan Street Railway	111½
New York & New Jersey Telephone	143
Westinghouse Manufacturing Company	180

At a special meeting of Metropolitan Street Railway stockholders the proposition to lease the Central Crosstown Railroad was approved. Under the lease the Metropolitan company agrees to guarantee the principal and interest of the funded debt of the Crosstown company and a rental of 15 per cent on Crosstown stock. The contract is dated February 8, and has been approved by the directors of both companies. The Metropolitan company owns $498,700 of the $600,000 capital stock, on which 10 per cent has heretofore been paid. The higher rate under the lease is made possible by the change from horse cars to the underground electric system. The directors of the Metropolitan Street Railway have declared the regular quarterly dividend of 1¾ per cent on the capital stock, payable April 15. Books will remain closed from March 24 to April 16.

Boston:	*Closing.*
American Telephone and Telegraph	123
Edison Electric Illuminating	230
Massachusetts Electric	72
New England Telephone	117
Western Telephone and Telegraph preferred	75

American Telephone and Telegraph directors have declared the regular quarterly dividend of 1½ per cent, payable April 15 to stock of record March 18. The instrument statement of the company for the month ended February 29 is as follows: gross output, 84,402; returned, 37,093, leaving a net output of 47,309, as compared with a net output of 56,656 for the same period of 1902. The total now outstanding is 3,880,616, compared with 3,296,527 last year.

Philadelphia:	*Closing.*
Electric Company of America	8
Electric Storage Battery common	57¾
Electric Storage Battery preferred	57¾
Philadelphia Electric	5 1/16
Union Traction	48⅜
United Gas Improvement	84¼

The balance-sheet of the Electric Storage Battery Company as of December 31, 1903, places the total assets of the company at $21,316,429, and the total liabilities at $18,343,797, leaving a surplus of $2,972,632. The company held its annual meeting on March 16 and elected the following directors for the ensuing year: Herbert Lloyd, P. A. B. Weidener, George D. Weidener, Thomas Dolan, Frank B. Schley, H. P. Whitney, A. N. Brady, Thomas B. Ryan and Rudolph Ellis.

Chicago:	*Closing.*
Chicago Telephone	115
Chicago Edison Light	148
Metropolitan Elevated preferred	49
National Carbon common	25
National Carbon preferred	99
Union Traction common	5½
Union Traction preferred	30

ELECTRIC LIGHTING.

BELOIT, WIS.—The common council has asked for bids for a municipal lighting plant.

OXFORD, N. C.—An electric light and waterworks system will be established here shortly.

NORFOLK, VA.—R. B. Fentress has made application for a franchise to install an electric lighting and heating system.

EDWARDSVILLE, ILL.—The electric light plant at Pinckneyville was destroyed by fire recently. The loss was $10,000.

AVON, N. Y.—The board of trustees has renewed the contract with the Avon Electric Company for lighting the village for another year.

LENOX, IOWA—A twenty-five-year franchise for an electric light plant has been granted to S. E. Wainwright. The plant will cost $7,000.

RIDGEFARM, ILL.—The electric light plant of the Ridgefarm Light and Power Company was destroyed by fire recently, entailing a loss of $9,000.

ST. PAUL, MINN.—The plant of the Union Light and Power Company, at St. Anthony Park, has been destroyed by fire, involving a loss of $50,000.

WARREN, OHIO—The village of Cortland will be lighted electrically hereafter, current being supplied by the Warren, Cortland & Jefferson Traction Company.

LINCOLN, NEB.—The city council has voted to submit to the people a proposition to issue $65,000 in bonds, to be used in building a municipal lighting plant.

SANTA CRUZ, CAL.—A company is to be formed to construct a new electric light plant near the beach, with a capital of $30,000, half of which has been subscribed.

WINDER, GA.—The new city electric light plant has been completed and the lights turned on. The plant is said to be first-class in every respect, and cost about $15,000.

BALTIMORE, MD.—The Maryland Telephone and Telegraph Company has been granted permission by the electrical commission to engage in the electric lighting business.

SAN FRANCISCO, CAL.—It is stated that the Big Creek Company will establish a large power plant at Chittenden, to furnish power to Watsonville, Gilroy and Hollister.

NEW WESTMINSTER, BRITISH COLUMBIA—The city council has entered into a ten-year agreement with the British Columbia Electric Railway Company for street lighting.

CHEYENNE, WYO.—An electric lighting system is to be installed at Fort D. A. Russel, Wyo., the contract having been awarded to a St. Paul, Minn., firm. The cost of the plant will be $23,965.

ANN ARBOR, MICH.—The Michigan Milling Company has filed with the city clerk a request for an electric lighting and power franchise. It is proposed to develop water power for electricity and do commercial lighting.

CINCINNATI, OHIO—A contract has been entered into between the Chamber of Commerce and the Cincinnati Gas and Electric Company, whereby the latter company will supply the Chamber of Commerce Building with electric lights until the first of March next.

BOSTON, MASS.—The Lowell Electric Light Company has filed with the secretary of the commonwealth a statement of its condition, dated June 30, 1903, which fixes the assets of the company at $1,034,605, and its liabilities at $866,802, leaving a surplus of $167,803.

UTICA, N. Y.—At the annual meeting of the Rome Gas, Electric Light and Power Company these directors were elected: James T. Lynn, Martin B. Daly, John D. McMahon, Thomas H. Stryker, Fred. M. Shelley, Edward Comstock, E. Faeger, W. R. Huntington, F. K. Pelton.

CHARLOTTE, N. C.—The board of aldermen has awarded a five-year contract for street lighting to the Catawba Power Company. The contract is to go into effect August 15 next, and the company will furnish 155 lights at the rate of twenty-five cents per lamp per night.

KEWAUNEE, WIS.—At the meeting of the city council it was unanimously decided to submit the question of electric light and waterworks to the people at the coming spring election. At the same time the question of municipal or private ownership will also be submitted to vote.

ST. LOUIS, MO.—A movement is on foot in North and Upper Alton to secure a lighting plant, to be used jointly. The idea is to locate the power-house midway between the two towns, which are only a few miles apart, and to secure a plant sufficiently large to fill the needs of both places.

JERSEY CITY, N. J.—Weehawken has decided to erect its own electric lighting plant for the township, and has directed the committee on lighting to have plans and specifications prepared for a plant to be installed in the new pumping station about to be completed in the lower section of the township.

FAYETTEVILLE, N. C.—Workmen are making the excavations and laying the foundations of the Fayetteville substation of the Cape Fear Electric Power Company, on Buckhorn Falls, Cape Fear river, from which electric power will be transmitted to the mills and other industrial plants of Fayetteville and vicinity.

SPOKANE, WASH.—Articles of incorporation of the Sandpoint Water and Light Company have been filed with the county auditor. The capital stock is placed at $50,000, and the incorporators are J. D. Sherwood, William G. Malloy, B. C. Riblet and L. D. Farmin. It is stated that work on the new plant will be commenced immediately.

CINCINNATI, OHIO—The change of the electric lighting of the city from the old to the new system, which was started in 1902, has been completed. There are now 4,923 electric lamps, of which 934 are in the underground and 3,989 in the overhead district. The city pays $60 a year for each overhead light and $72 for each underground.

ASHEVILLE, N. C.—At the mouth of Jonathan's creek, on Pigeon river, a big water power development is to be made to furnish electric power to be used in Waynesville. The plant will be built by a company to be headed by B. J. Sloan. It is planned to build a thirty-foot dam of masonry and 1,500 horse-power is to be developed.

AMSTERDAM, N. Y.—The Citizens' Electric Company, of Amsterdam, has been incorporated with the secretary of state to make and sell electricity for light, heat and power purposes. The capital stock is $50,000, and the directors are William W. Dickson, Frank W. La Chapelle, Maurice G. Walsh, George C. Stuart and W. Fenton Myers, of Amsterdam.

ST. LOUIS, MO.—The board of public improvements is planning a municipal electric lighting plant for that portion of the city south of Keokuk street. The plant will cost about $140,000. It will be located on Kraus street, near the river. At present the city pays the Carondelet Gas Company and the Welsbach Lighting Company $59,000 a year for lighting the district.

EUGENE, ORE.—The Cottage Grove Electric Company has filed articles of incorporation with the county clerk. The capital stock is $20,000, and the incorporators are H. O. Thompson, William Sheehy and K. Sheehy. The company has purchased the Cottage Grove electric plant from W. H. Abrams and will hereafter conduct it, making extensive improvements and extending the service.

MARTINSBURG, W. VA.—A charter has been issued to the Cacapon Power Company, of Berkeley Springs, to own and operate an electric plant. The capital of the company is $100,000. The incorporators are F. R. Reed. J. H. Siler, of Berkeley Springs; Morrison. Barclay, John Shumaker and Thomas Barclay, of Greensburg, Pa. This company will develop 600 horse-power, and will transmit it across the mountain, a distance of four miles, to operate the machinery of the mills in the vicinity of Berkeley Springs and Hancock, Md., as well as light the two places.

TROY, N. Y.—With the building of the big power-house at Spier Falls the Hudson River Water Power Company also contemplates the erection of a substation at Ballston. Material is already on the ground and preliminary plans have been made for the work at Ballston. Building operations will begin in the early spring. The new substation will stand on a site one-quarter of a mile west of the Delaware & Hudson station on the line of the Schenectady railway. It will be of brick and its electrical equipment will provide 6,000 horse-power. Power for the Ballston-Schenectady branch of the Schenectady railway will be supplied from this station, and the village of Ballston as well will be lighted.

ELECTRIC RAILWAYS.

BARABOO, WIS.—W. J. Bell is endeavoring to interest business men in an electric line to extend from Baraboo to Grand Rapids. Baraboo, Kilbourn, Friendship and Grand Rapids would be the principal points touched.

NEW HAVEN, CT.—It is announced that the Wallingford Tramway Company, which holds a franchise to build a trolley line from the terminus of the Meriden road in Wallingford to Montowese, will begin work very soon. The new road will be seven miles long.

COLFAX, WASH.—The preliminary survey of the Palouse & Spokane Electric Railroad is being made. The road will follow the line surveyed by the Northern Pacific about sixteen years ago, when it ran a survey from Oakesdale, west of Steptoe butte, to Colfax.

SPRINGFIELD, ILL.—The secretary of state has licensed the Springfield, Lincoln, Bloomington, Pekin & Peoria Electric Railway Company, of Bloomington. A line is to be constructed from Springfield through Lincoln to Bloomington and from Lincoln to Peoria.

OWOSSO, MICH.—The Owosso Sugar Company's line from Prairie Farms, near Fergus, which will be built this summer, will probably be the first to run into Owosso. The distance that it will run is twenty miles, and it will penetrate through 10,000 acres, of which one-fifth will be placed under beet sugar cultivation.

HEMPSTEAD, N. Y.—The power-house of the New York & Long Island Traction Company, which has been under construction at Rockville Centre for some time, has been completed, and the company has started the work of extending its tracks west from Rockville Centre through Lynbrook and Valley Stream to Jamaica.

SOUR LAKE, TEX.—It is reported that the International & Great Northern Railway has consummated a deal that will place it in possession of the incompleted electric line between Sour Lake and Beaumont. It is also said that the road will be completed within sixty days, and that it will be extended to Houston, going *via* Batson.

HENDERSON, KY.—Articles incorporating the Henderson Street Railway Company under its new management have been filed. The incorporators are A. L. Rich, of Cincinnati, Ohio; H. W. Richardson and J. E. Bohannon, of Louisville, Ky. The amount of capital stock is $250,000, and the company is authorized to issue bonds to that amount.

ROCK ISLAND, ILL.—The Tri-City Railway Company will make many improvements to its plant on First avenue. The present capacity of the plant is between 1,200 and 2,000 horse-power, which is to be increased to from 6,000 to 7,000. The changes will involve a large expenditure, but will be made without any interruption to the service.

BAKER CITY, ORE.—The Baker City Electric Street Railway Company will begin the work of constructing its line of road just as soon as the weather will permit. The company has been reorganized and reincorporated with a new set of officers. C. M. Sage is president, Charles Palmer is vice-president and treasurer, and Charles W. Hill is secretary. These three gentlemen comprise the board of directors.

CORTLAND, N. Y.—The increasing demand for electric lights and the proposed extension of the electric road to Little York has made it incumbent upon the Cortland County Traction Company to increase its power. To this end plans are now being drawn for enlarging the power-house situated between this city and Homer to twice its present size, and the power of the engines will be increased from 1,100 to 2,000 horse-power.

TERRE HAUTE, IND.—Promoters of the proposed interurban electric line from East St. Louis to Terre Haute, at a meeting held at Vandalia, decided to push the work as far as Greenville in time for the mid-summer traffic of the World's Fair, and effected a permanent organization by the election of W. M. Fogler, president; C. G. Sonnemann and H. C. Dolye, vice-presidents; George D. Steinhauer, general manager; T. N. Lakin, treasurer, and W. A. Hayward, secretary.

SPOKANE, WASH.—The Washington Water Power Company is said to have secured the old Seattle, Lake Shore & Eastern right of way from Spokane to Medical Lake, and will build an electric line connecting the two places. The Seattle, Lake Shore & Eastern started to build a railroad from Spokane to the coast a number of years ago and reached Davenport. The Northern Pacific paralleled the line and bought it out. Later the tracks were torn up at this end and the right of way has since been idle.

DENVER, COL.—Articles of incorporation have been filed with the secretary of state for the Bear Lake Valley Railway and Electric Company. The power of an electric plant at Paris, Bear Lake County, Idaho, is to be utilized in operating a new electric car line in that vicinity, which will connect the towns of Paris, Montpelier, Fish Haven and Ovid. The headquarters of the corporation will be in Denver. It is capitalized at $100,000, and the incorporators are C. R. Slusser, H. E. Slusser, B. E. Slusser and George D. Talbot.

LEXINGTON, KY.—The Fayette County Fiscal Court has revoked the charter of the Bluegrass Consolidated Traction Company, incorporated here two years ago with a capital stock of $7,000,000, and granted a franchise to the Bluegrass Traction Company, of which Charles J. Bronston is president. The new concern is to have a capital stock of $100,000, and has the privilege of increasing the capital stock to $1,000,000. It proposes to build lines between Lexington and the following towns: Versailles, Richmond and Nicholasville.

TOPEKA, KAN.—The Kansas Southern Electric Railroad Company has been chartered. The company's object is to build an electric line from Kansas City to Independence, through Johnson, Miami, Douglas, Allen, Franklin, Anderson, Neosho, Crawford, Labette, Cherokee and Montgomery counties. The company's capital is $1,500,000. The incorporators are F. V. Crouch, J. F. Thompson, A. W. Beck, G. A. Bowhis and W. L. Bartels, of Iola, and J. H. Osborn, Charles Schaffner and S. J. Stewart, of Humboldt. The company will have headquarters at Iola.

ALBANY, N. Y.—There have been filed with the secretary of state at Albany the requisite legal papers consolidating the Warren & Jamestown Electric Railroad Company of New York with the Warren & Jamestown Electric Street Railway Company of Pennsylvania. The corporate name of the consolidation will be the Warren & Jamestown Street Railway Company. The company has plans to connect Warren and Jamestown through Frewsburg by trolley, and the work is now in process. The officers of the corporation are as follows: president, David H. Siggins; vice-president, Charles H. Gifford; secretary, George C. Priestly; treasurer, John M. Siegfried.

WABASH, IND.—The annual meeting of stockholders of the Union Traction Company of Indiana and its allied interests, the Indianapolis Northern and the Indiana Union Traction Company, was held in Anderson recently. The directors elected for the Union Traction Company of Indiana are as follows: Phillip Matter, Marion; J. Levering Jones, Philadelphia; James A. Van Osdol, Anderson; William C. Sampson, of Muncie; Ellis C. Carpenter, Anderson; Hugh McGowan, Indianapolis, and Arthur Brady, Muncie. The new board organized by electing the following officers: president, Phillip Matter; vice-president, Ellis C. Carpenter; treasurer, William C. Sampson; secretary, James A. Van Osdol. The directors elected for the Indianapolis Northern are as follows: George F. McCulloch, Muncie; Randall Morgan, J. Levering Jones, Henry M. Kingston, John Harris, Jr., Philadelphia; W. Kesley Schop, Cincinnati; Arthur W. Brady. The financial statement for the Union Traction Company of Indiana shows that the gross earnings of the lines for the past year were $1,118,951.54. The operating expenses were $620,136.64, leaving net receipts of $498,814.90. The fixed charges, including interest accounts, taxes, licenses and dividends on preferred stock, are $358,511.19, and the net income for the year applicable to rental payments is $140,303.71.

AUTOMOBILE NOTE.

SERVICE TEST OF MOTOR WAGONS—The rules governing the service test of motor wagons, which will be held from April 4 to April 9, 1904, under the auspices of the Automobile Club of America, have been so amended as to add the following classes for heavy trucks: seventh class, to carry a dead load of 6,000 to 8,000 pounds; eighth class, to carry a dead load of 8,000 to 10,000 pounds, or over. These heavy trucks will be placed in the service of the H. Clausen & Son Brewing Company, to be used over its regular routes for the week April 4 to April 9. All of the rules previously published will govern in the heavy classes.

INDUSTRIAL ITEMS.

THE MARSHALL-SANDERS COMPANY, Boston, Mass., reports a phenomenal demand for its "Dow" adjuster. This furnishes a neat method of adjusting an incandescent lamp cord. The cord is reeled up into the receptacle after the fashion of a curtain adjuster.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., in the April number of "Graphite" gives considerable interesting information with regard to the uses and utility of its products. In this number are listed thirty-five products, varying in character from stove polish to resistance rods for electrical work.

THE STERLING ELECTRIC MANUFACTURING COMPANY, Warren, Ohio, is again calling attention to the "Sterling Special" lamp with several attractive mailing folders. These folders compare the "Sterling Special" with the regular type of lamp, and show some interesting figures regarding candle-power, life and economy.

HARVEY HUBBELL, Bridgeport, Ct., manufacturer of incandescent lamp sockets, clusters and lighting specialties, is distributing a beautiful poster hanger which depicts a fashionable interior equipped with the Hubbell pull cluster. There has been a big demand for these specialties, and this market will probably be increased during the coming season.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., has issued a new price list dated April, 1904. This price list applies to the company's latest catalogue, and in it are quoted the latest discounts and prices prevailing on all electric material. The book is made up attractively, and the company requests that all purchasers of material who have not received a copy will write for one.

THE AUTOMATIC ELECTRIC COMPANY, Chicago, Ill., announces that the Citizens' Telephone Company, of Columbus, Ohio, has increased its order placed with the company some time ago. The original order called for a complete automatic equipment for 7,000 stations initial installation. The new order makes the number 8,000. The Citizens' company will build a new house for the automatic exchange, which will be designed especially for this type of equipment.

THE NATIONAL ELECTRIC COMPANY, successor to the Christensen Engineering Company, Milwaukee, Wis., will exhibit its electrical and air-brake apparatus at the St. Louis fair. Part of its exhibit will include a 1,500-kilowatt alternating-current generator. This unit will be in operation at the central power station, furnishing power for various purposes. In addition, a number of smaller alternating and direct-current machines will be exhibited at its space, including a complete exhibit of the Christensen air-brake equipment.

THE HOLTZER-CABOT ELECTRIC COMPANY, Boston, Mass., in bulletin No. 149 disseminates a lot of valuable information with regard to the wiring and installation of interior telephone systems. In bulletin No. 148 there are described and illustrated a number of different styles of telephones especially adapted for interior and industrial systems. The present bulletin, No. 149, illustrates the number of different ways in which these telephones can be connected up, so that they will render the proper class of service required in different installations.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, Cincinnati, Ohio, has just received an order from the Denver Gas and Electric Company, Denver, Col., for one 1,500-kilowatt, 2,400-volt, three-phase, 100 revolutions per minute, sixty-cycle, flywheel-type generator. This machine is a duplicate of one the company installed at the same station about a year ago. The Denver Gas and Electric Company has also installed four 600-kilowatt, three-phase, 2,400-volt alternators, which makes a total of 6,000 kilowatts in Bullock alternators installed.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., and Chicago, Ill., is mailing to its customers a handsome souvenir calendar. This calendar is tastefully worked up, and contains, in addition to a lithographed reproduction of an American Beauty rose, a photographic print of a lady using a telephone in what appears to be the corridor of an opera-house. In order to avoid an indiscriminate distribution of these calendars, the publication department of the Stromberg-Carlson company has made it a point to exact five two-cent stamps from those requesting a copy.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., illustrates and describes in bulletins Nos. 4367 and 4368 fuse plug cabinet panels and continuous-current motor-controlling panels respectively. Bulletin No. 4367 is very complete in its treatment of fuse plug cabinet panels and contains many interesting illustrations. No. 4368 is equally complete in every detail connected with continuous-current motors and controlling panels. The company has also sent out its supplement to supply catalogue No. 7569, superseding pages 6 and 7. Both of these bulletins and the supplement will be sent on request.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., and New York city, N. Y., has sent out its 1904 catalogue, illustrating and describing its "Trojan" fan motors. This catalogue is neatly made up and treats the subject in a plain understandable manner. Many good half-tones are shown. It contains list prices for hanger rods for ceiling fans, parts for desk and bracket fans, parts for ceiling fans, and has a list of telegraphic code words. The company has also sent out its 1904 catalogue describing its complete line of "Emerson" fan motors. Both of these catalogues will be sent on request.

THE STANDARD ELECTRICAL MANUFACTURING COMPANY, Niles, Ohio, has established an office at 19 Park place, New York city, to properly handle its growing eastern business. The company reports a good business for its "Star" lamps, and an unusual success with its special "street railway lamp." An addition to its line will be in the form of a three and three-quarter-inch frosted bulb, twenty-five-candle-power reflector lamp. This will fit any standard fixture and is designed for general interior work. Mr. J. Rice will be sales manager in charge of the New York office. It is intended to make prompt shipments from stock which will be carried in the new office, when this is desired.

LEGAL NOTES.

ELECTRIC COMPANY IN DIFFICULTIES—A judgment for $15,253 has been entered against the Swan Electric Manufacturing Company, in favor of William J. Wilson, on five notes of the company payable to Robert Winthrop & Company, who delivered them to Mr. Wilson. The summons was served on Daniel Nason, president of the Swan Electric Company, at 55 William street, New York city. The company was incorporated in August, 1901, with a capital stock of $250,000.

EXTENSIVE LITIGATION TO PROTECT INCANDESCENT LAMP PATENTS—Announcement has been made that the Edison Electric Light Company, Schenectady, N. Y., is bringing an extensive series of suits for infringements of three patents which it owns, respectively, Nos. 537,693, 726,293 and 444,530. The first is the original patent granted to Arturo Malignani, of Undine, Italy, on a process of evacuating incandescent lamps. This is popularly known as the "chemical exhaust." The second patent is one issued to John W. Howell, and is an improvement on the Malignani process. It was granted on April 28, 1903. The third patent is to Thomas A. Edison, and is a detail patent, and consists essentially in "tying a knot" between the platinum and the copper wires. These wires are welded together and the glass seal is then squeezed around them from a piece of glass tubing. The knot sealed in the glass prevents any danger of the platinum wire working up and down, and thus becoming slightly loosened in the glass and making minute air cracks. A number of companies have taken out licenses from the Edison Electric Light Company, as follows: Columbia Incandescent Lamp Company, Sunbeam Incandescent Lamp Company, Buckeye Electric Company, Bryan-Marsh Company, Fostoria Incandescent Lamp Company, New York & Ohio Company, General Incandescent Lamp Company. The following dealers are among those mentioned in the suits brought for infringement of these patents: Cleveland Electric Manufacturing Company, Cleveland, Ohio; E. G. Bernard Company, Troy, N. Y.; Miller-Seldon Electric Company, Detroit, Mich.; L. P. Clark & Company, Philadelphia, Pa.; Iron City Engineering Company, Pittsburg, Pa., and Watts & Uthoff, St. Louis, Mo., and several others. In addition to these, there are fifteen manufacturers of incandescent lamps against whom suits have been brought.